FREDDIE MAC INVESTOR DAY

VIRTUAL EVENT SERIES 2021

June 8, 2021

MIKE REYNOLDS

VICE PRESIDENT
SINGLE-FAMILY CRT
FREDDIE MAC

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PRESIDENT
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Freddie Mac
Single-Family

Investor Day
Virtual Event Series 2021

Economic and Housing Market Update

Sam Khater

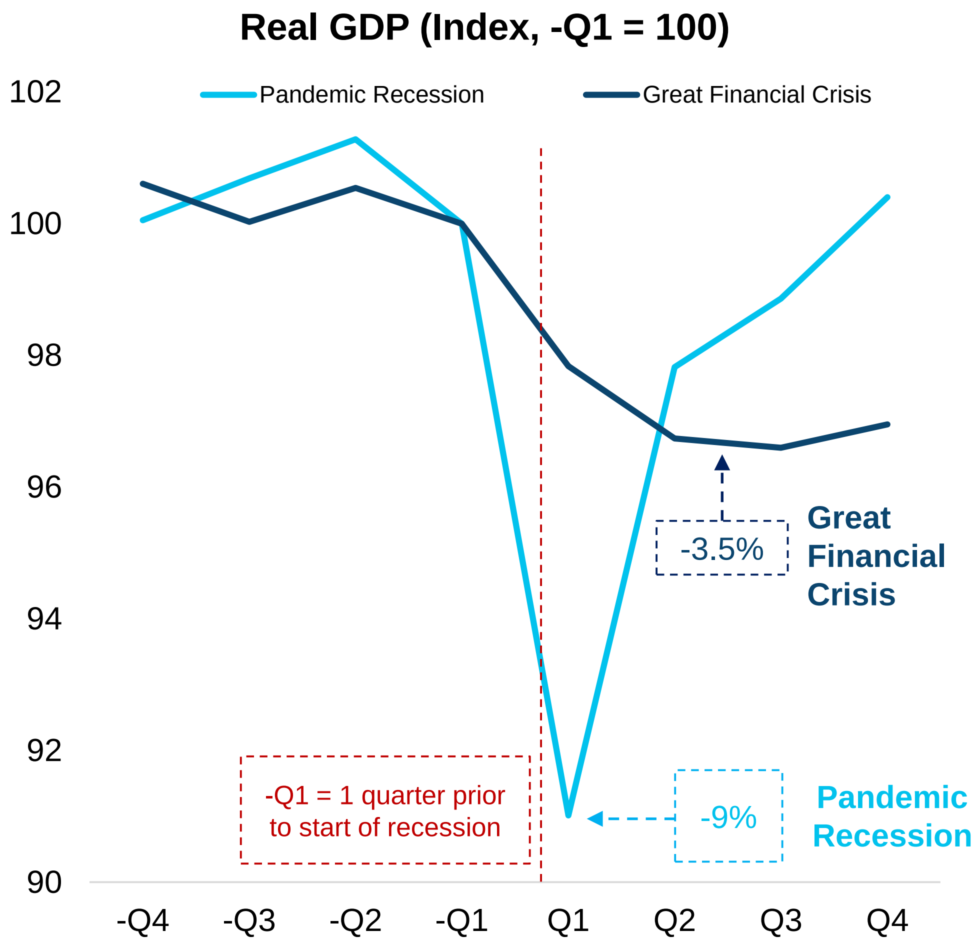
Vice President and Chief Economist, Economic and Housing Research

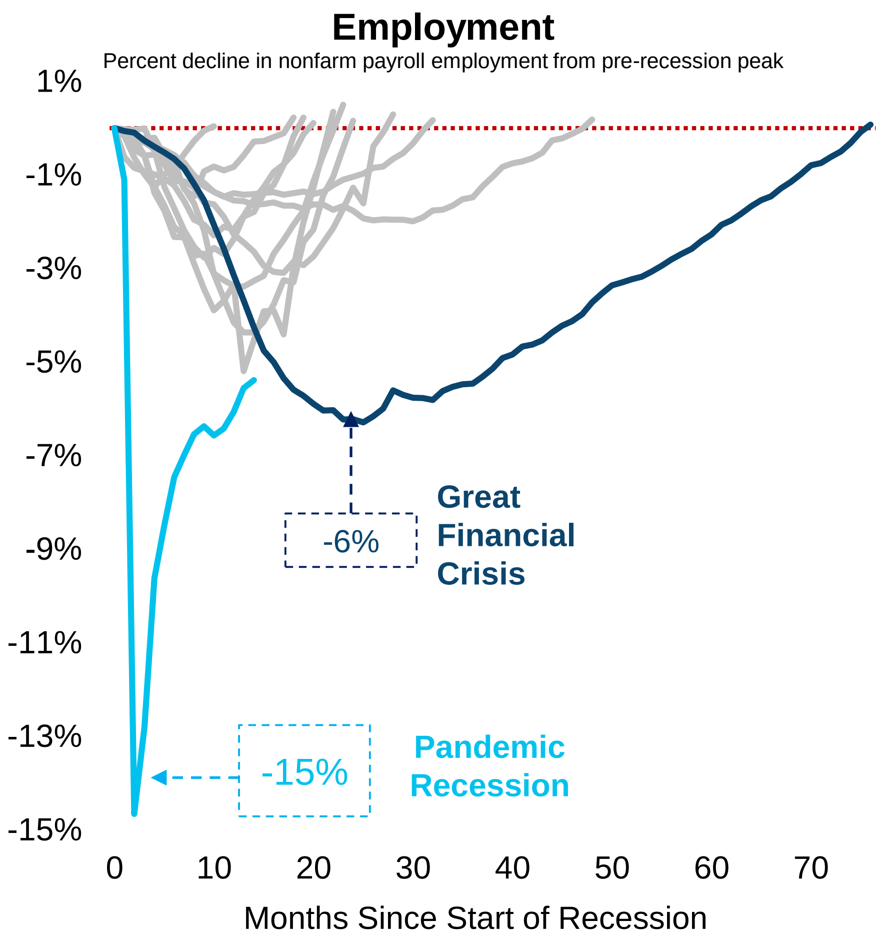
Tuesday | June 8 | 2021

Summary

- Economy is experiencing a surge in spending and growth
- The surge is driven by re-openings, stimulus and organic improvement in economy
- However, growth remains uneven, choppy and hampered by still weak labor market
- Inflation is accelerating and will continue to do so due to housing over next 1 to 2 years
- Housing remains hot, but demand cooled & low inventory led to high home price growth
- Lack of supply remains a large obstacle in the housing market and will very slowly improve
- Wealth effect has led to a large improvement in high end real estate market
- Migration is highest in last few decades, many home buyers moving out of expensive coastal areas or downtown locations and to the suburbs

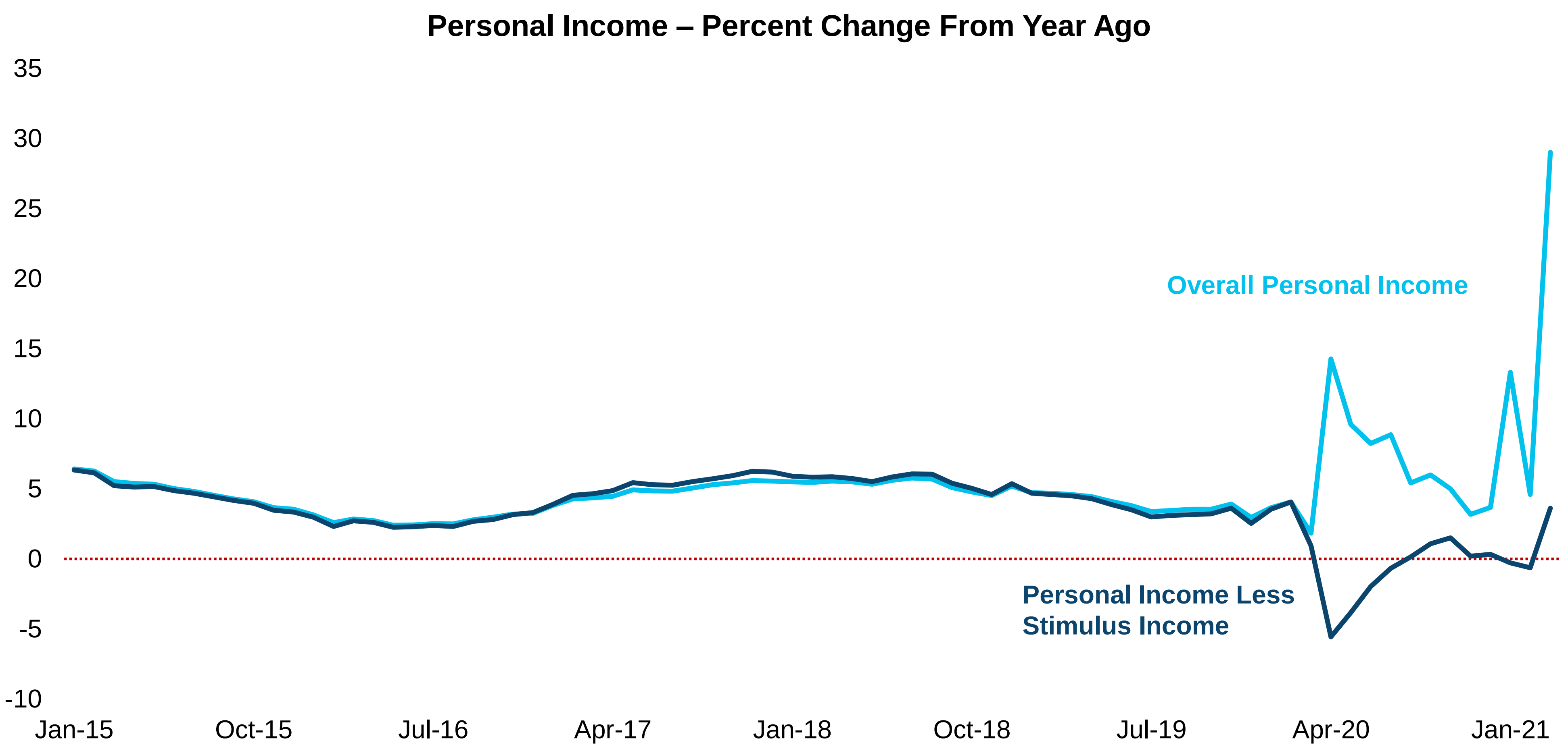
Economic Growth Has Recovered, Employment Has Not





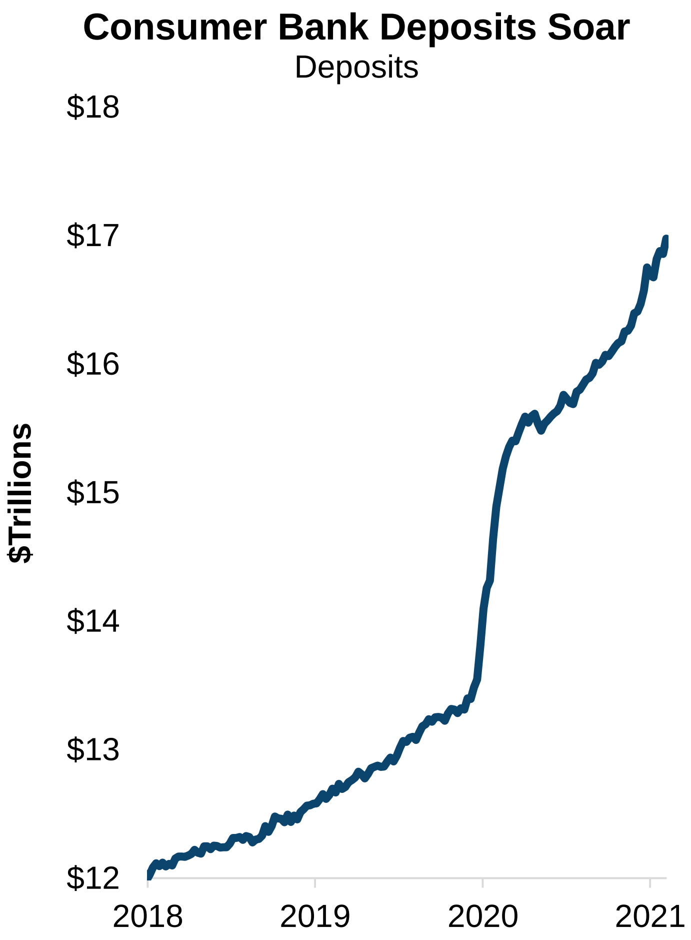
Source: BLS and BEA.

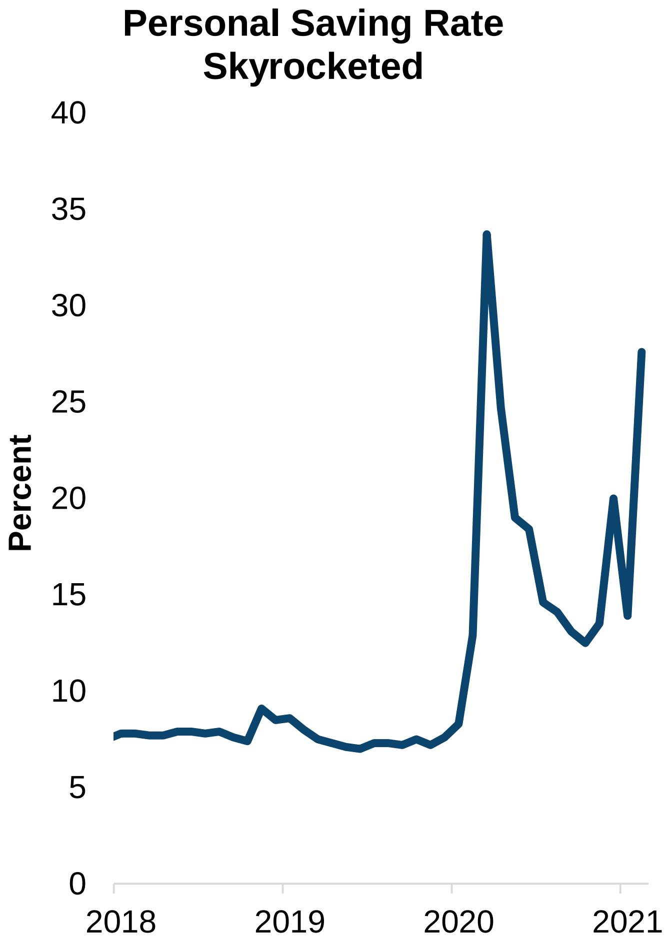
Surge in Employment Is Needed Because Stimulus Income Will Fade by Summer

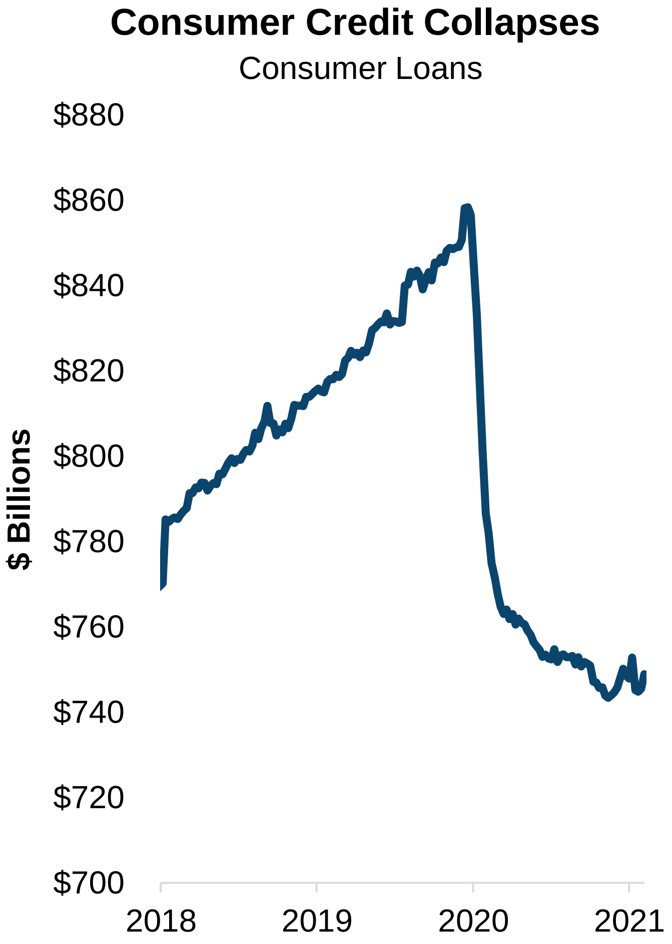


Source: BEA.

Consumer Balance Sheets Flush With Cash From Stimulus

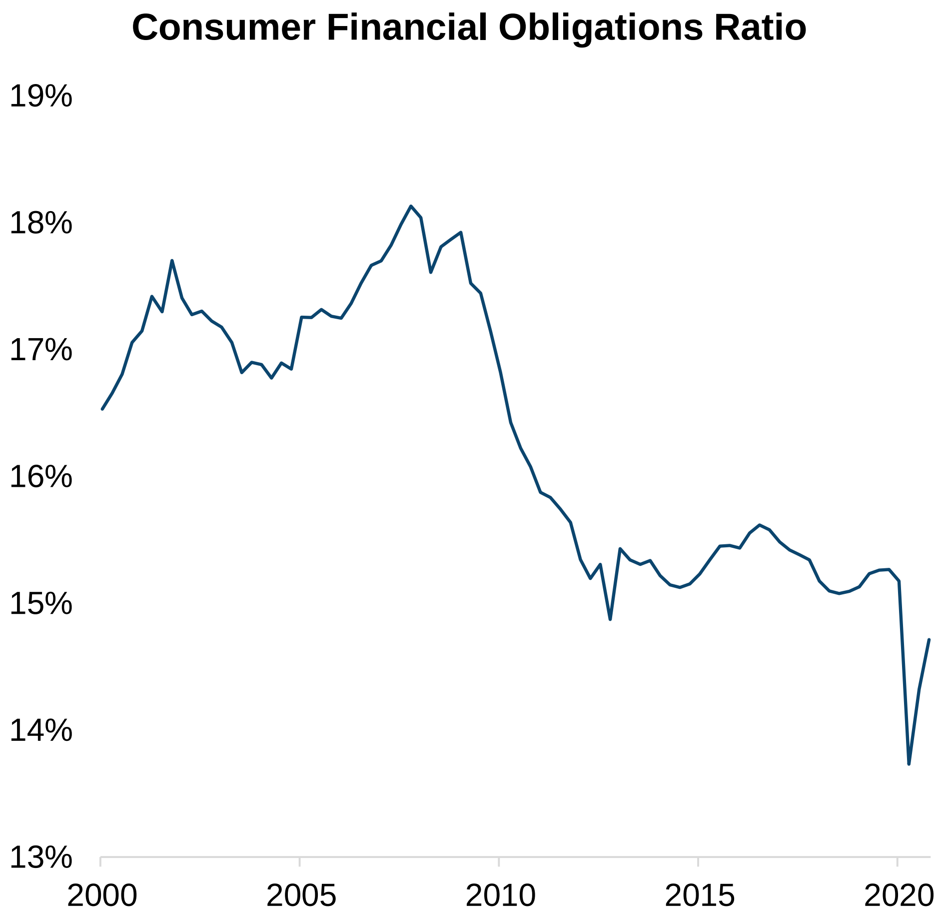


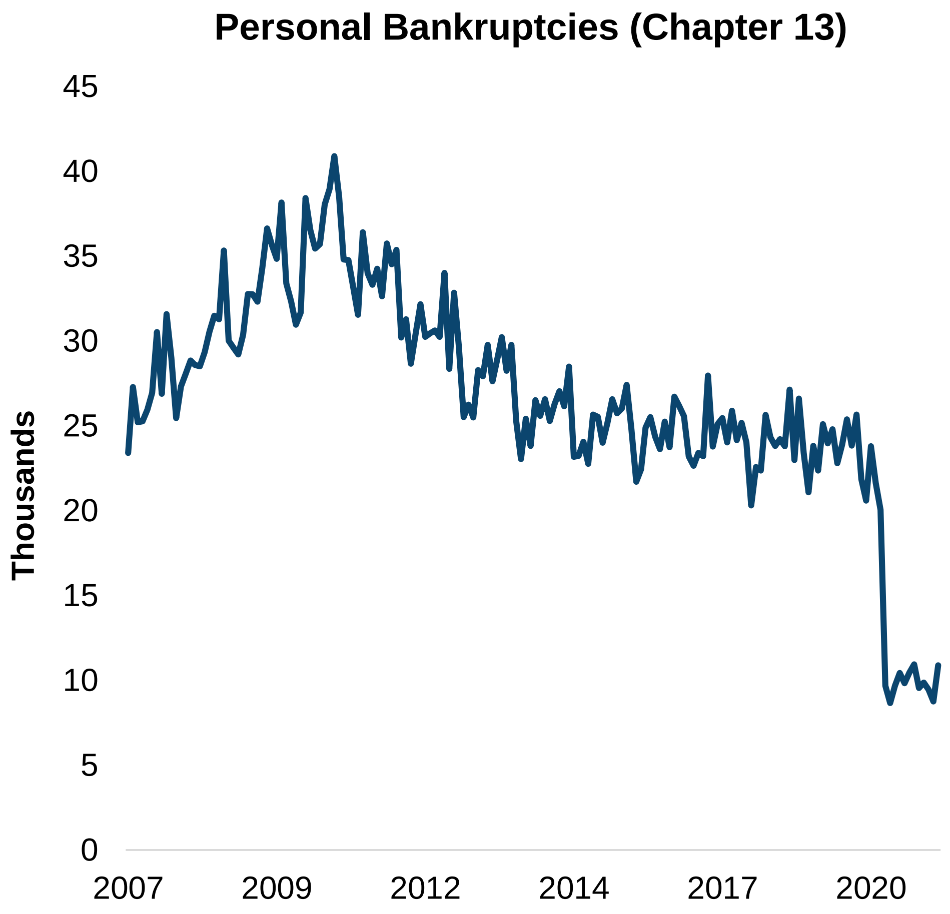




Source: FRB and BEA.

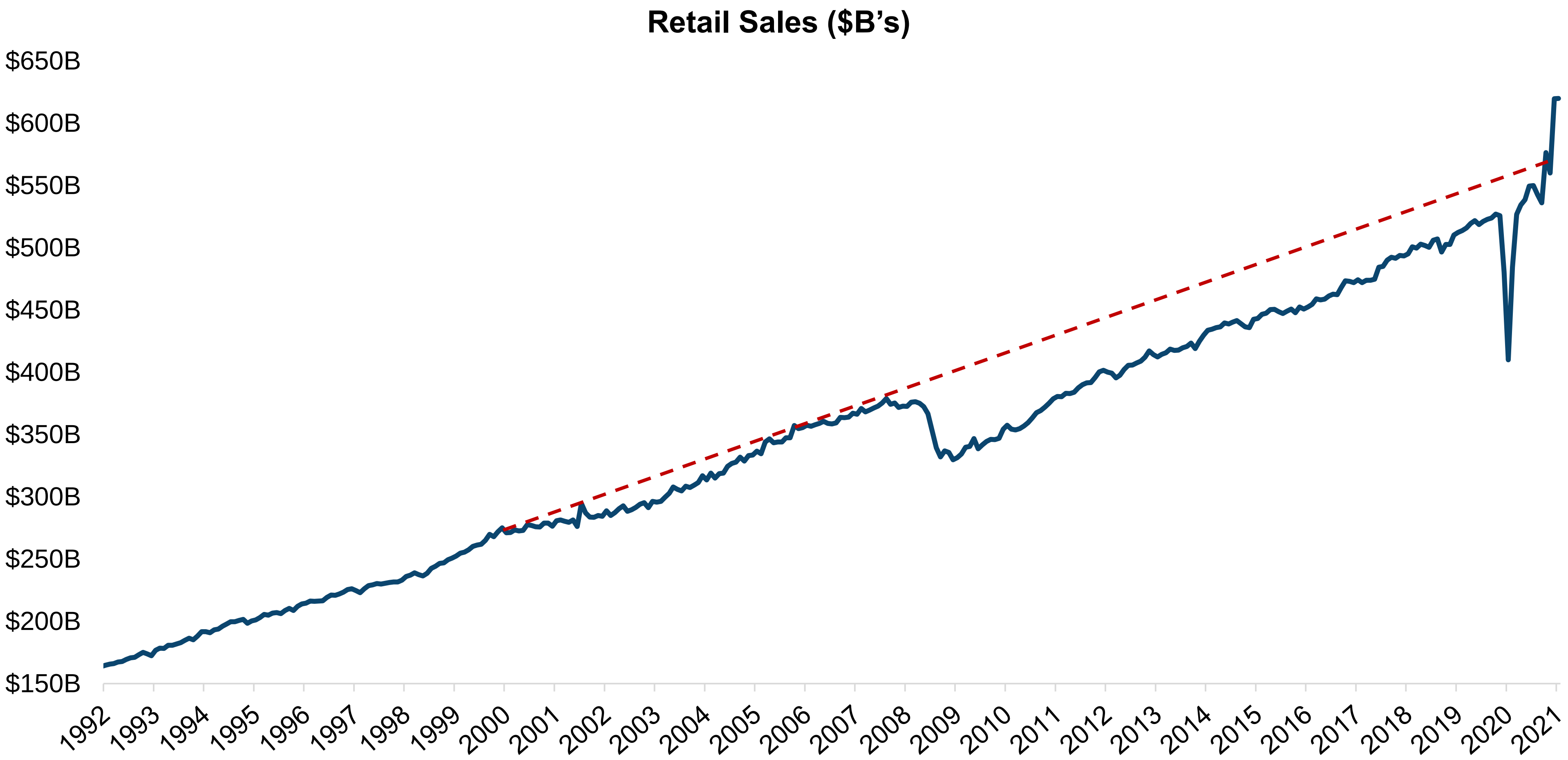
Low Mortgage Rates and Stimulus Led to Much Lower Consumer Financial Obligations





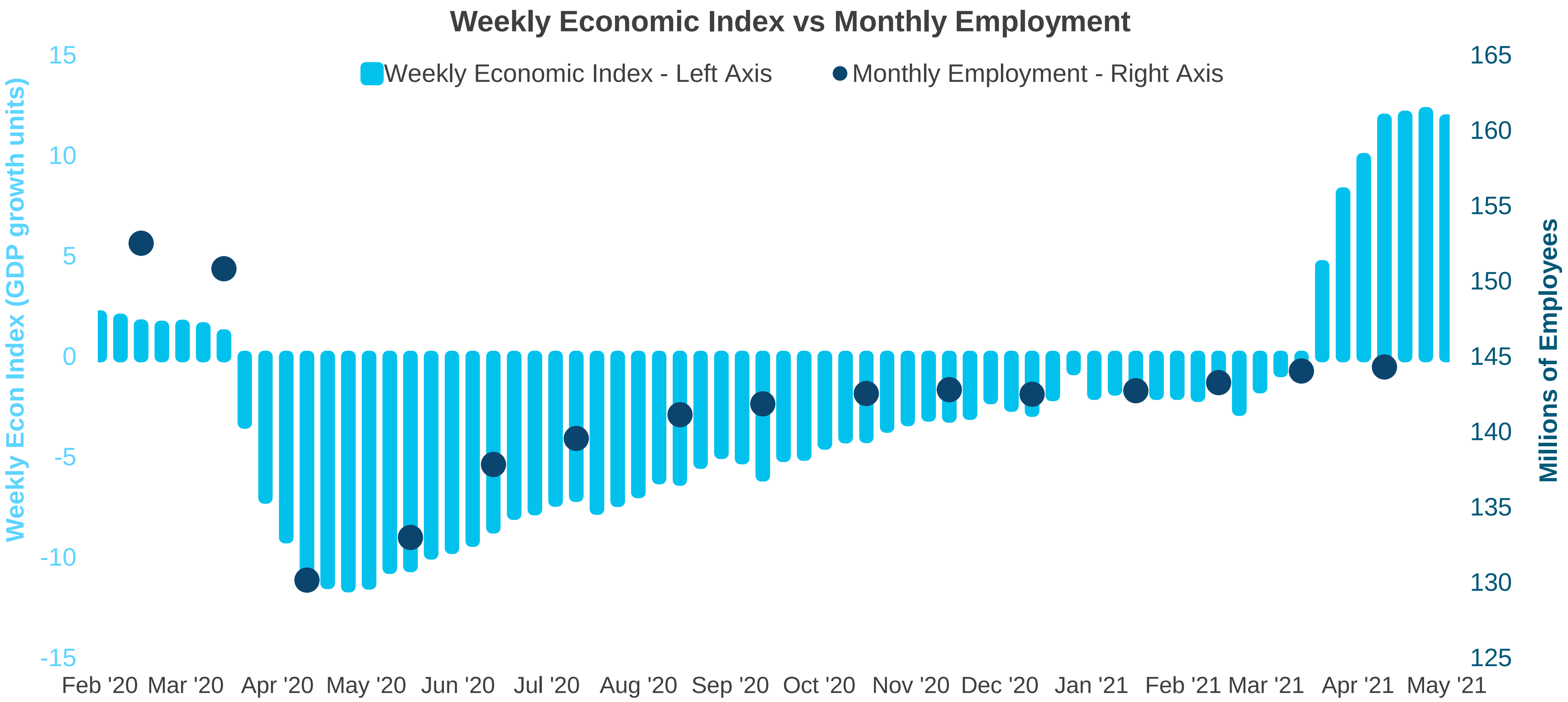
Source: Administrative Office of U.S. District Courts and Federal Reserve.

Re-Opening of Economy and Stimulus Causes Surge in Consumer Spending



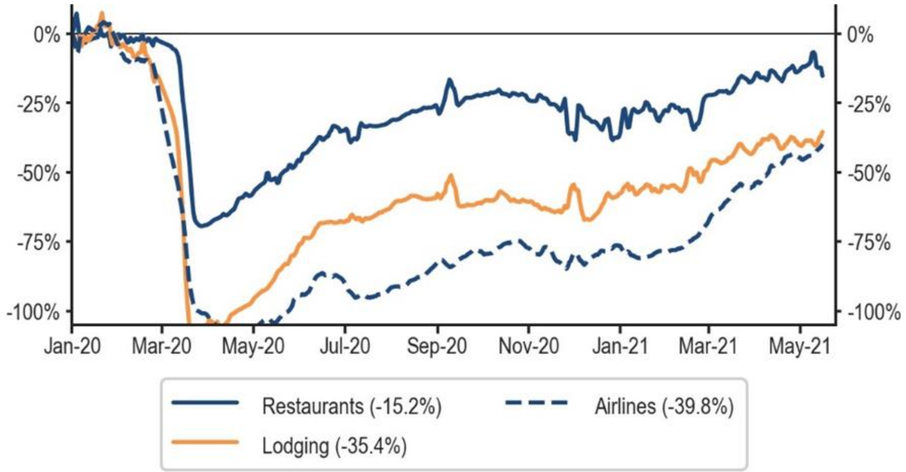
Source: U.S. Census Bureau.

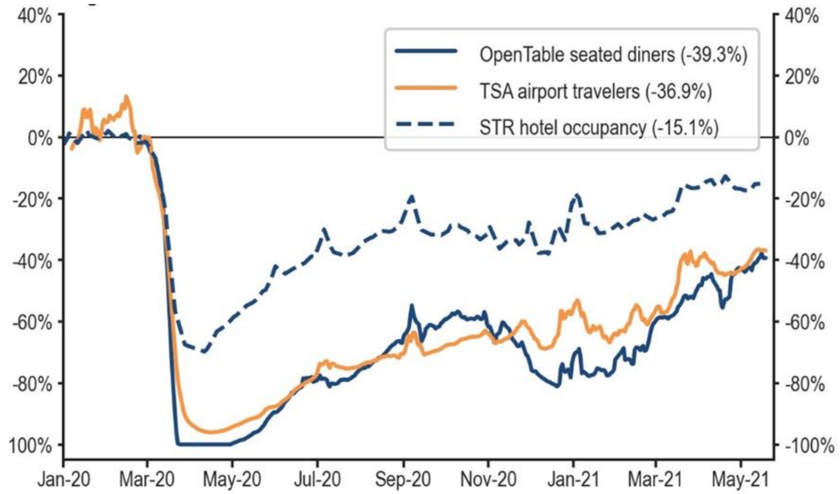
Incoming Data Suggest Economic Surge Already Underway and It Should Lead to Stronger Hiring, but It's Not Occurring Yet

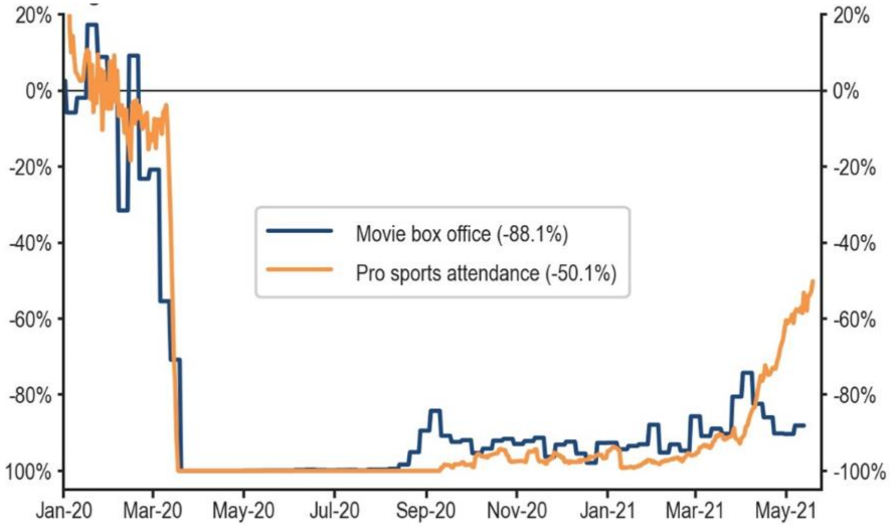


Source: BLS and Federal Reserve Bank of New York.

Daily Credit Card Spending Data Shows Consumers Becoming More Comfortable With Going Out

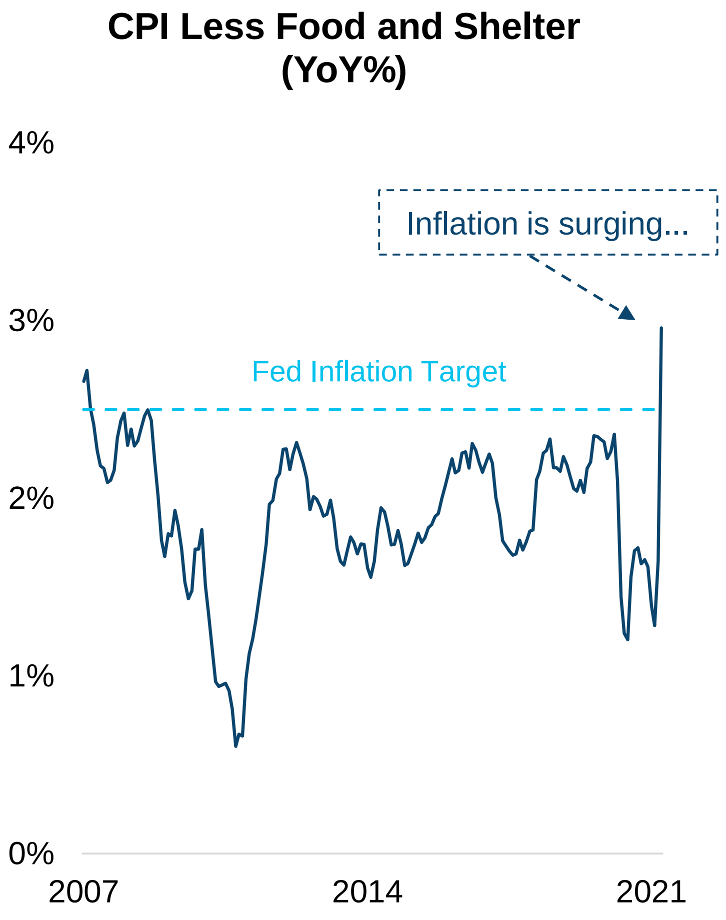


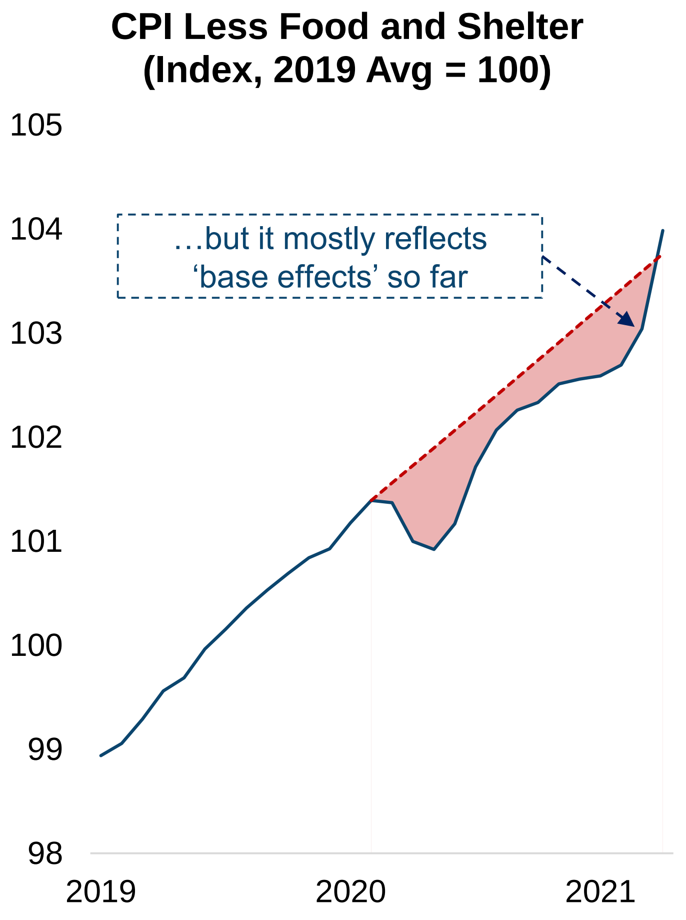


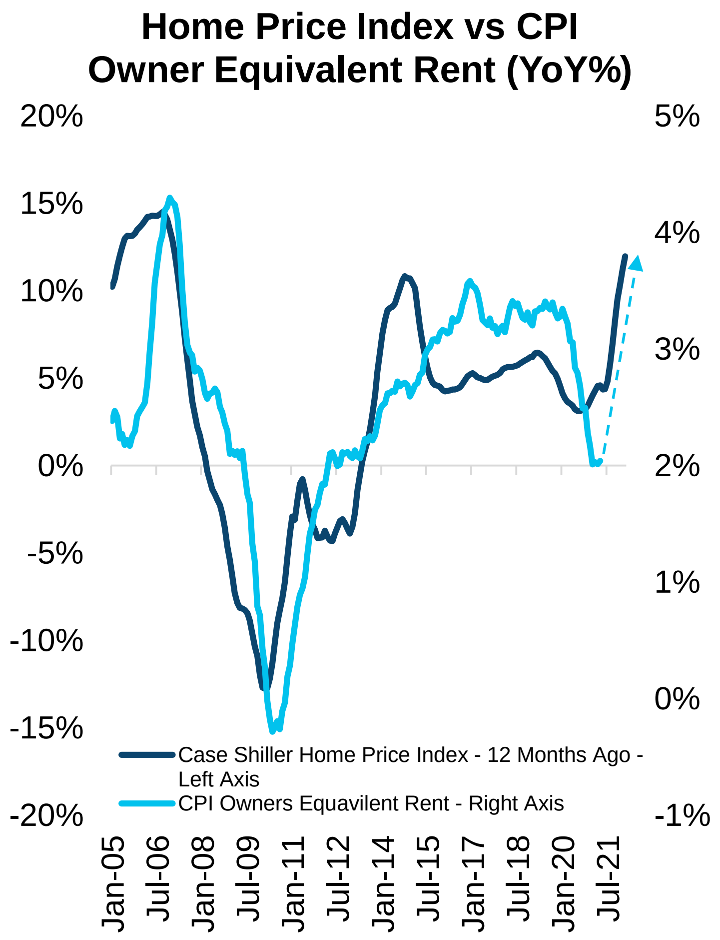


Source: JP Morgan.
Note: All data is for percent change from pre-COVID trend.

Inflation Rising Due to Base Effects, Will Continue to Rise Because of Temporary Supply Shortages and Housing Inflation, but Longer-Term Demographics, Automation and Outsourcing Is Deflationary

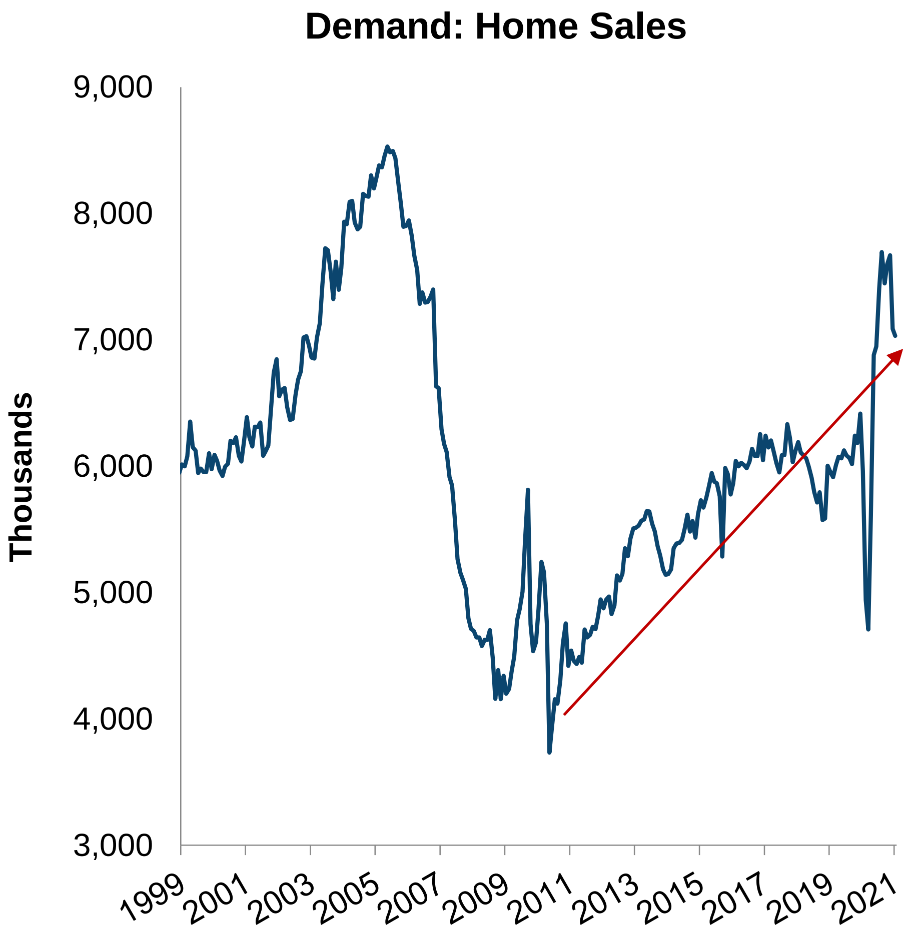


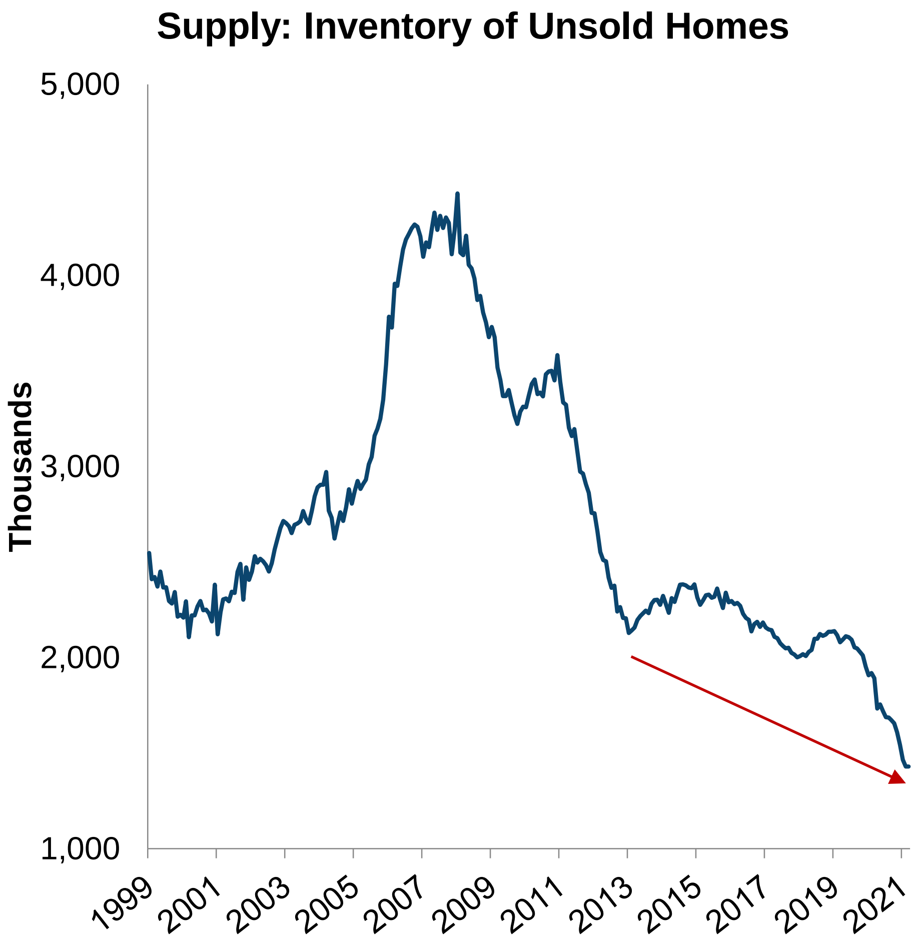




Source: BLS.

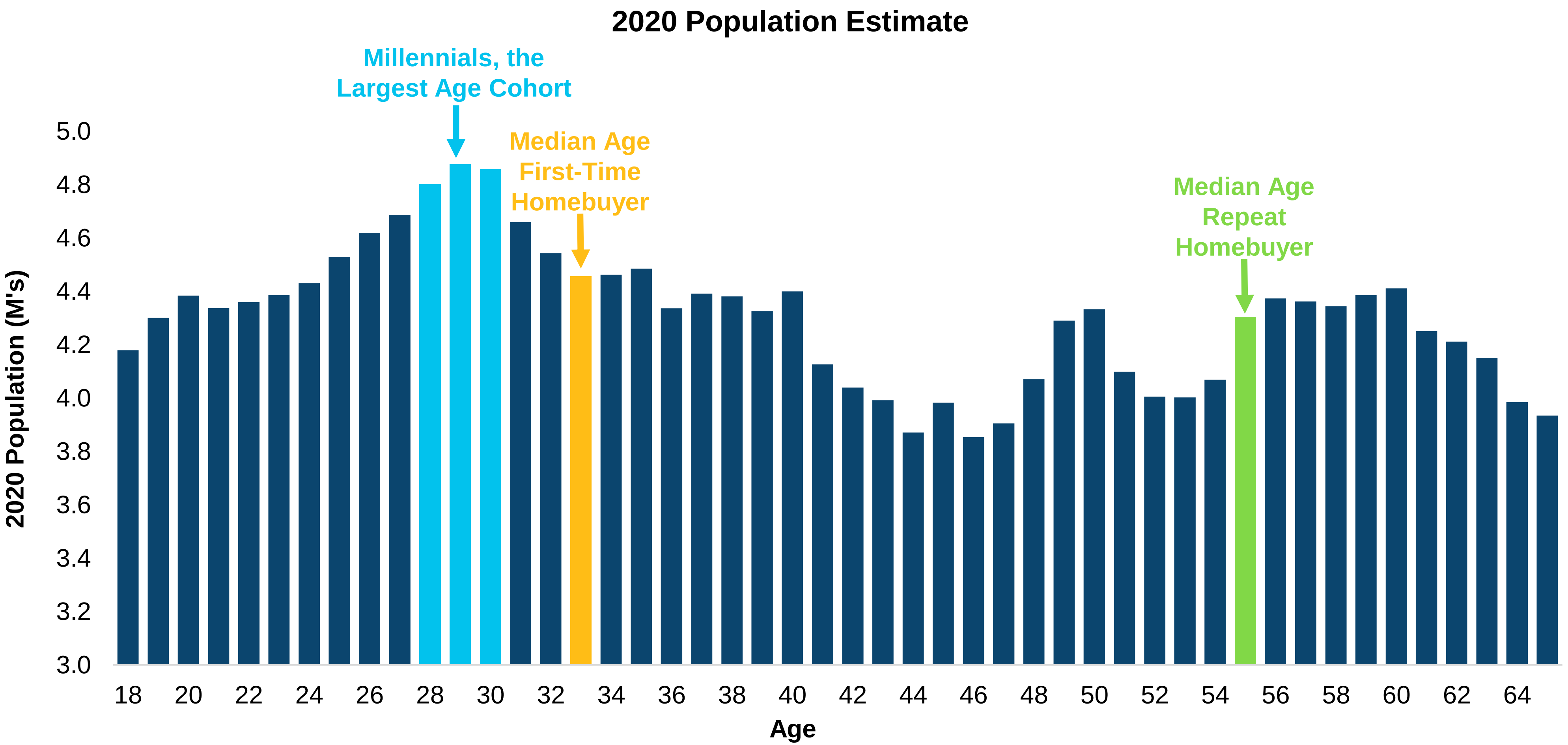
Home Sales Surged During Recession and Inventory Decline Accelerated





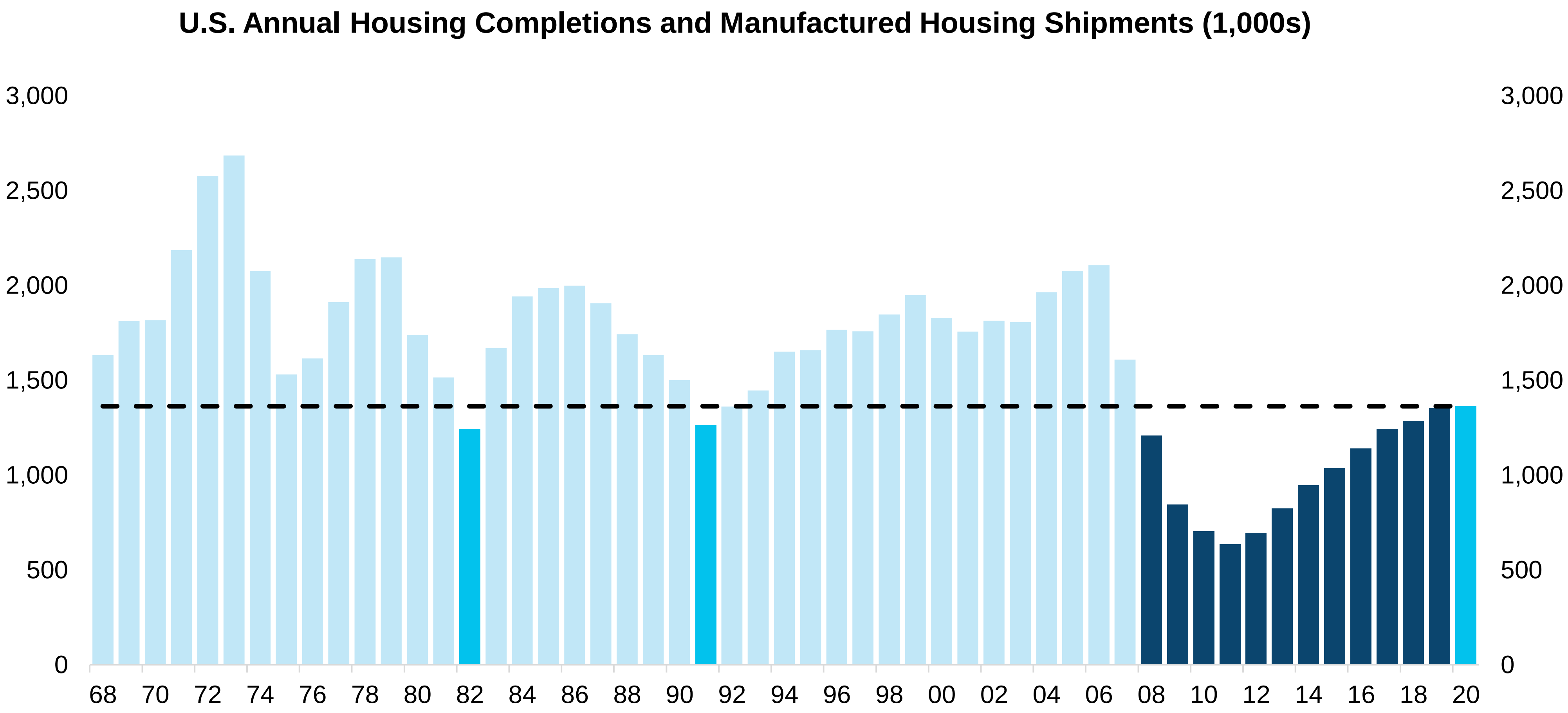
Source: NAR and U.S. Census Bureau.

Demographic Demand Is a Tailwind for the Market



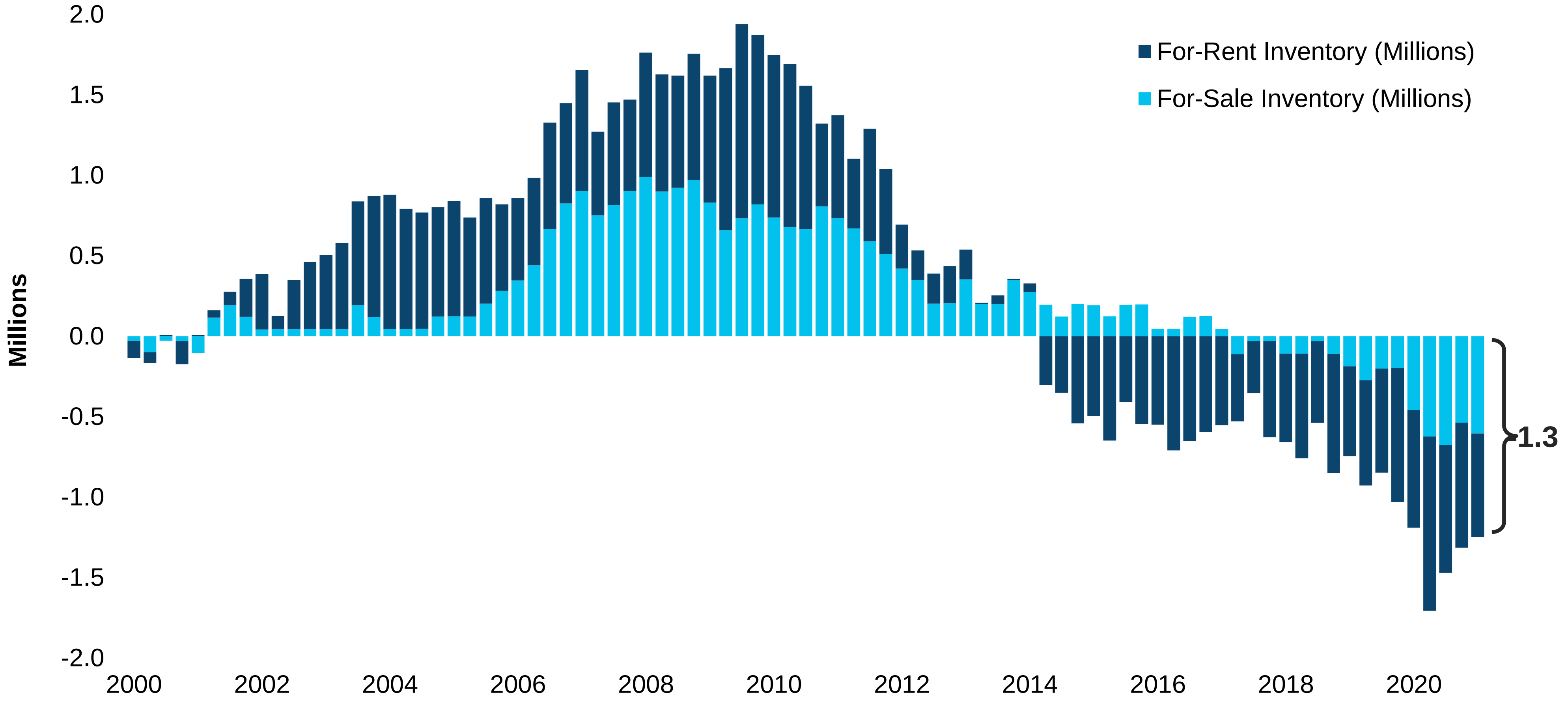
Source: NAR and U.S. Census Bureau.

New Housing Supply Remains at Recession Levels and Is Main Driver of the Boom in Home Prices



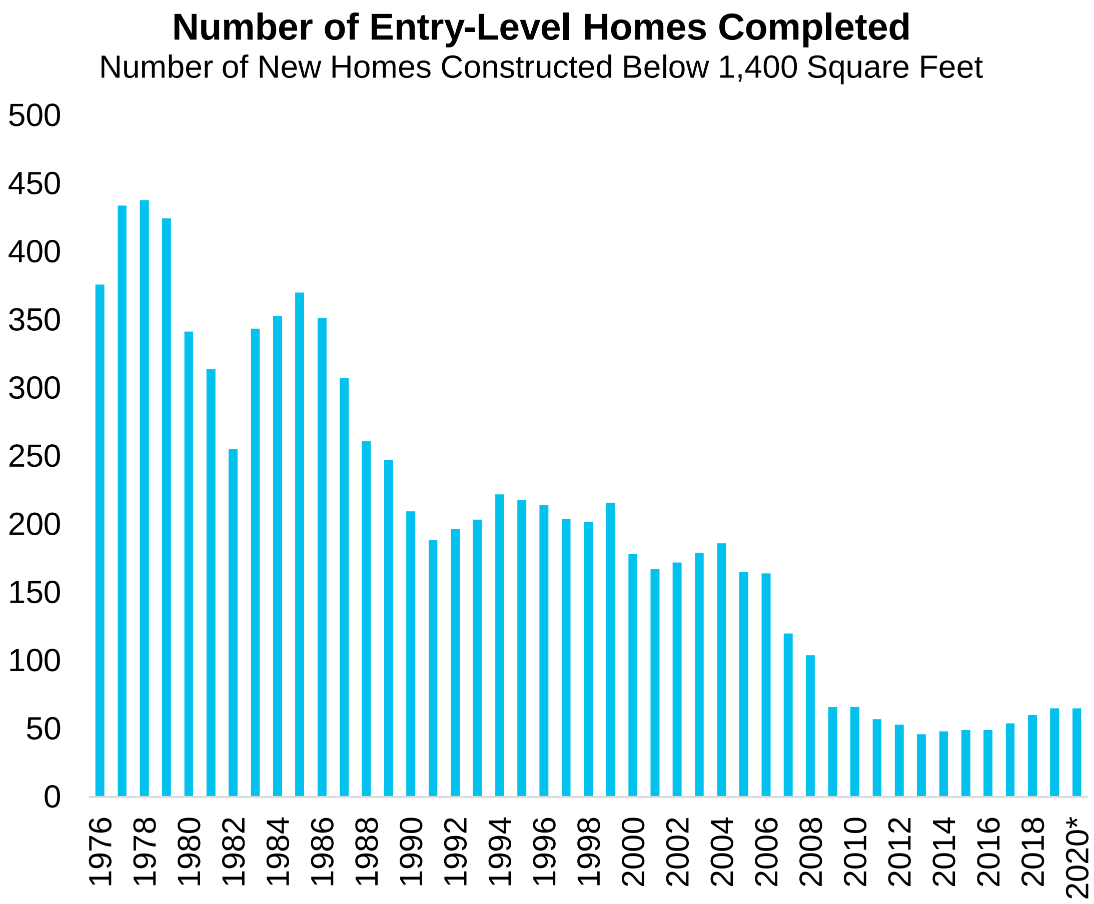
Source: Freddie Mac, U.S. Census Bureau and Department of Housing and Urban Development, Institute for Building Technology & Safety.

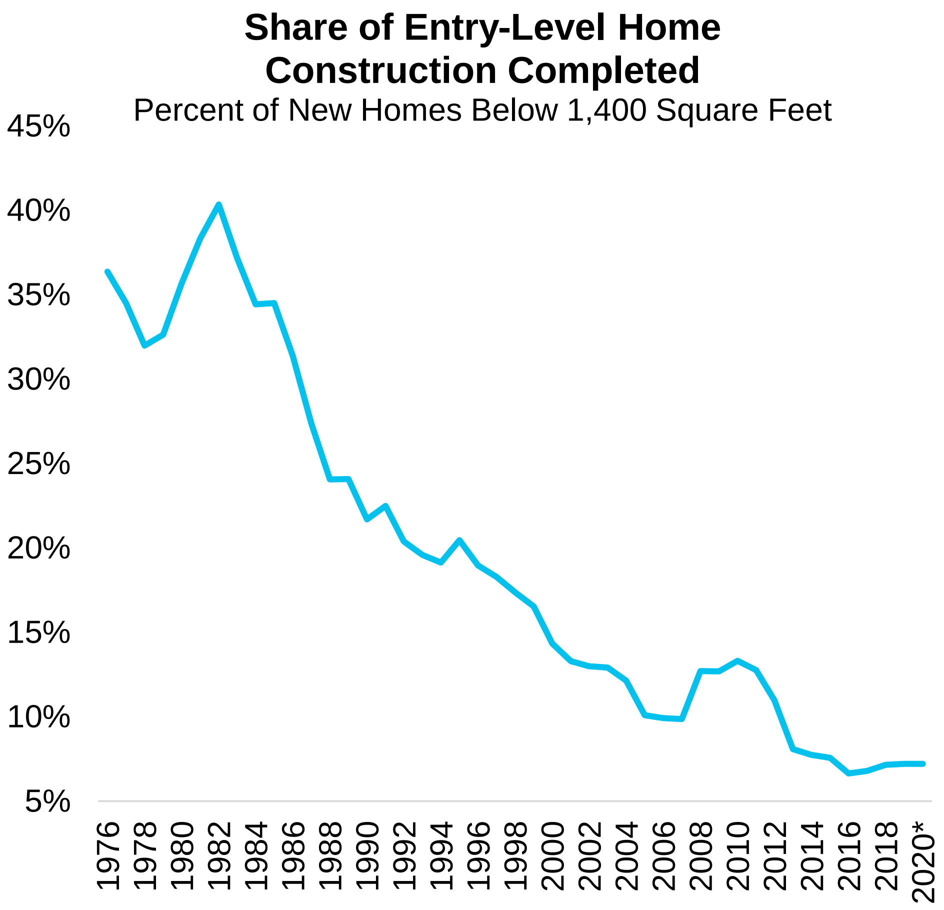
Unlike the Great Recession, Which Had Large Oversupply of Homes, the COVID-19 Recession Has Large Housing Shortage



Source: Freddie Mac calculations using US Census Bureau data. Negative values reflect undersupply. The under/oversupply of vacant housing was estimated based on the average vacancy rate from 2000 Q1 to 2020 Q2.

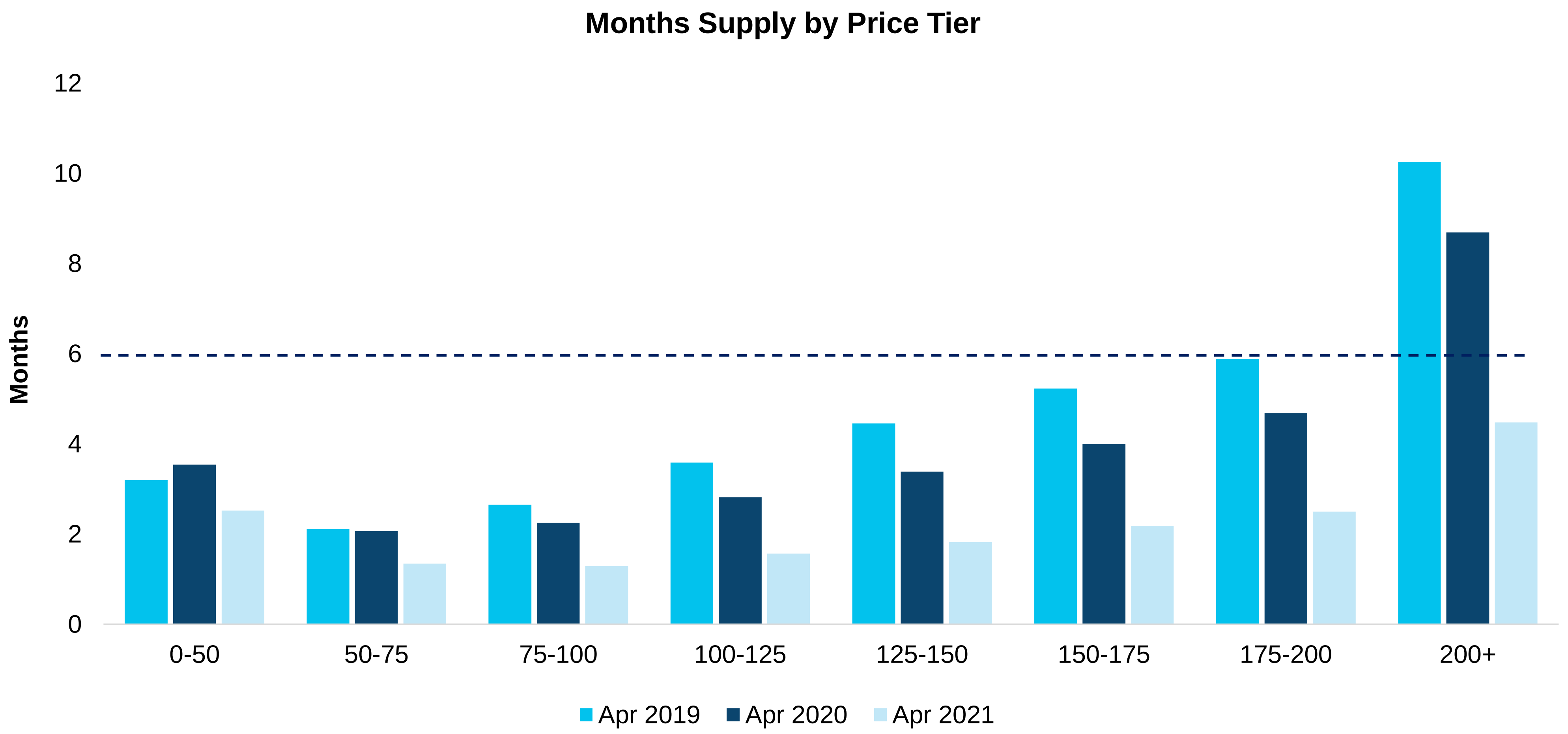
The Housing Shortage Is Concentrated in Entry-Level Affordable Homes





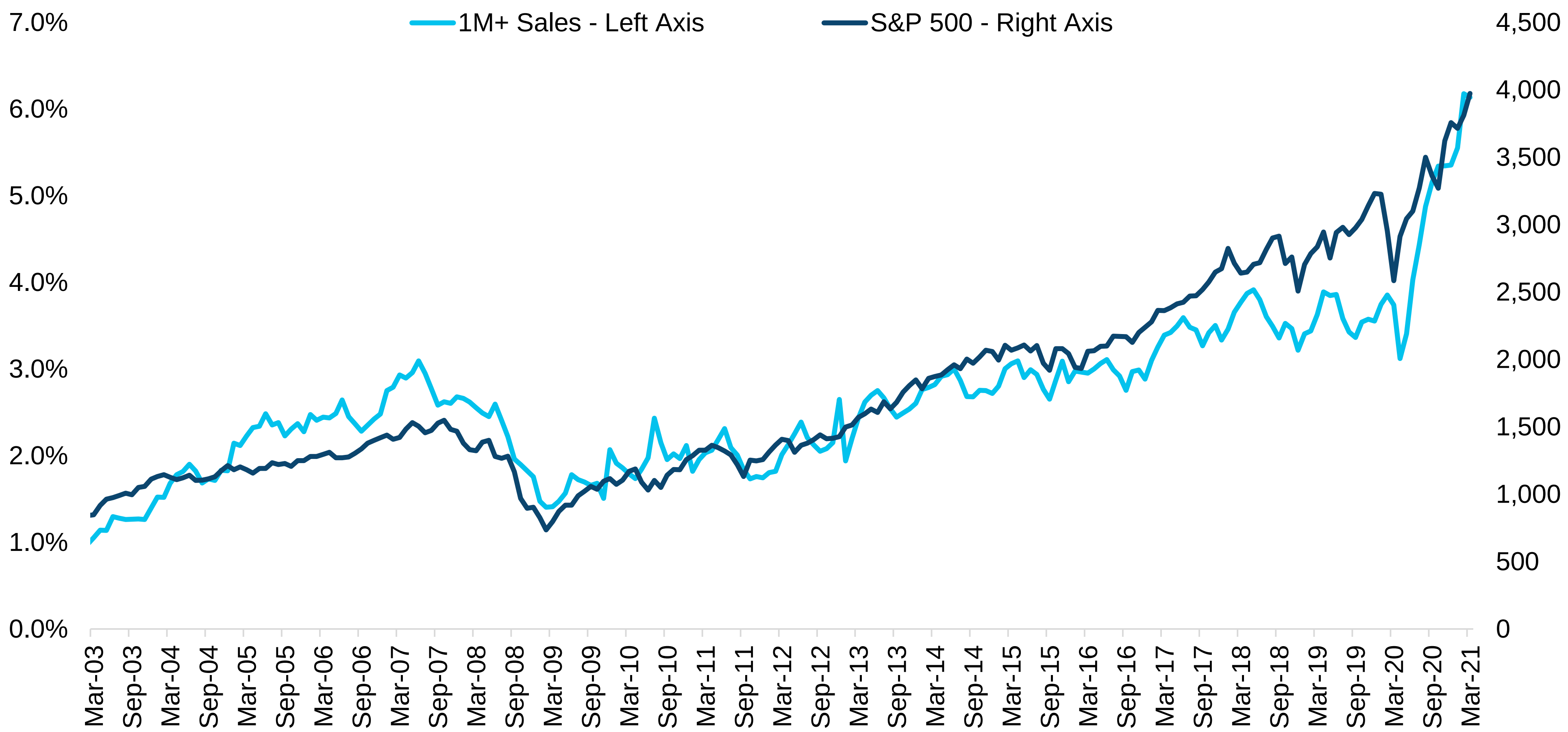
Source: Freddie Mac.

Months Supply of Inventory Is Tight Across Most Price Tiers, High End Improving the Most Recently



Source: CoreLogic. Note: Price tier represents the listing price divided by the metropolitan area median listing price. If a home is at the median listing price, the price tier is 100.

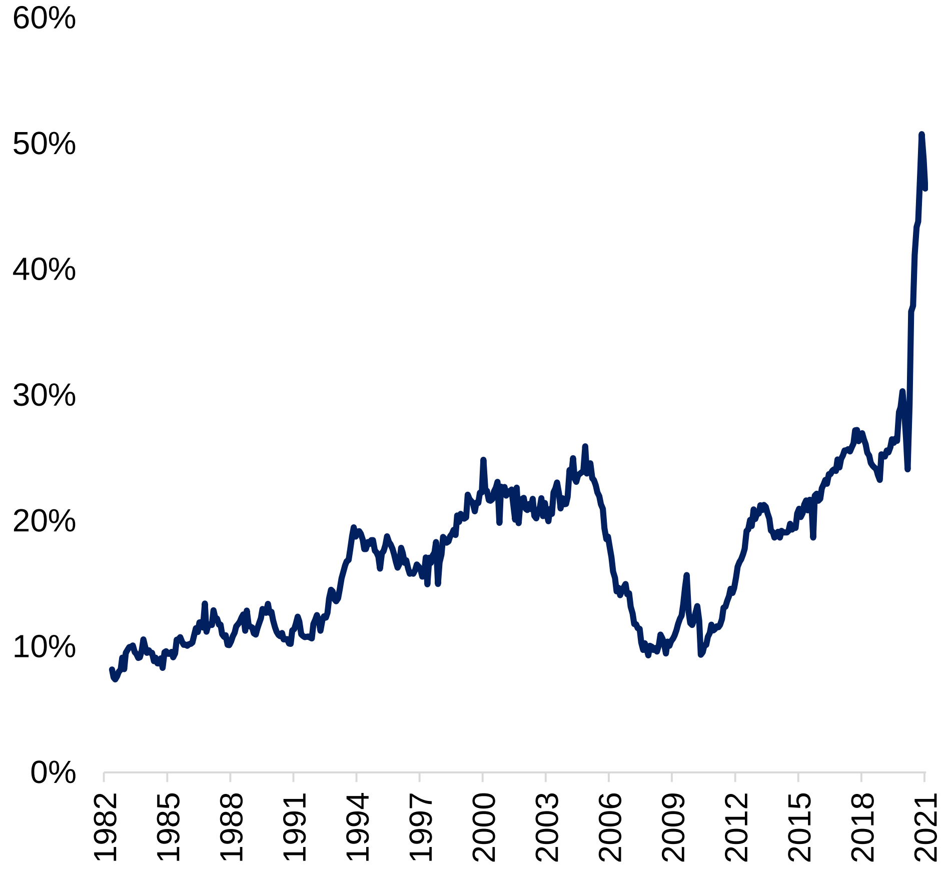
Stock Market 'Wealth Effect' Goes Into Overdrive



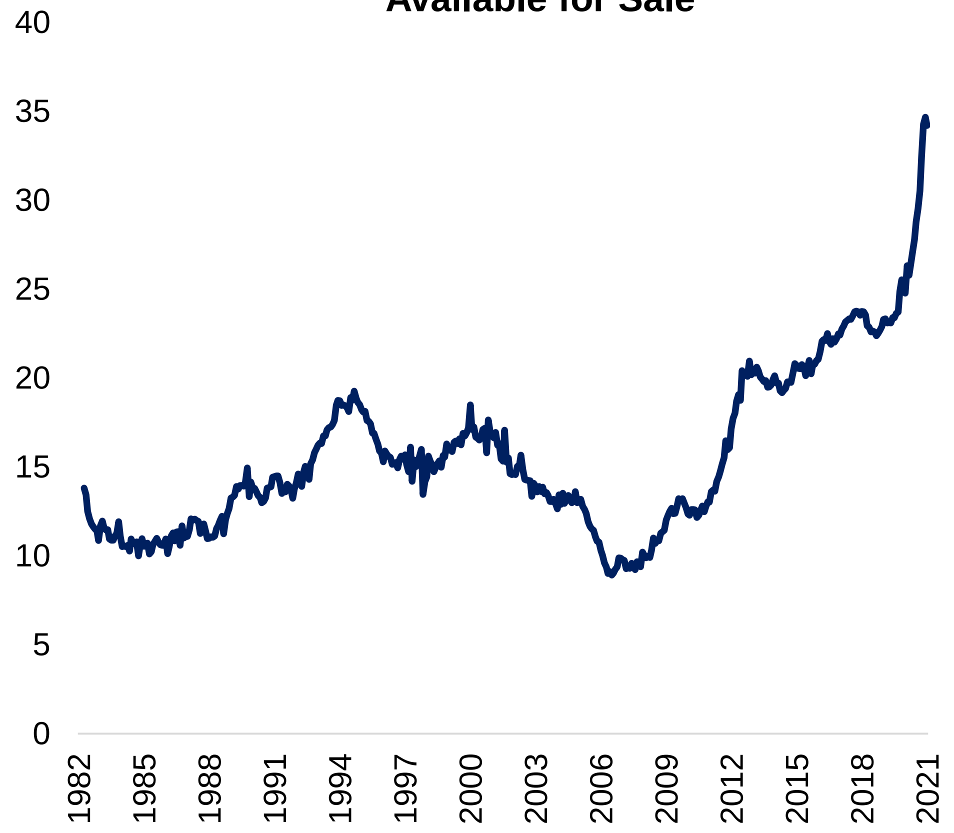
Source: CoreLogic and Standard and Poor's.

Absorption of Inventory Is Twice the Rate of Mid-2000s Bubble and the Lack of Housing Supply Means Renters Scramble for Shrinking Inventory of Homes to Purchase

Residential Single-Family Absorption Rate

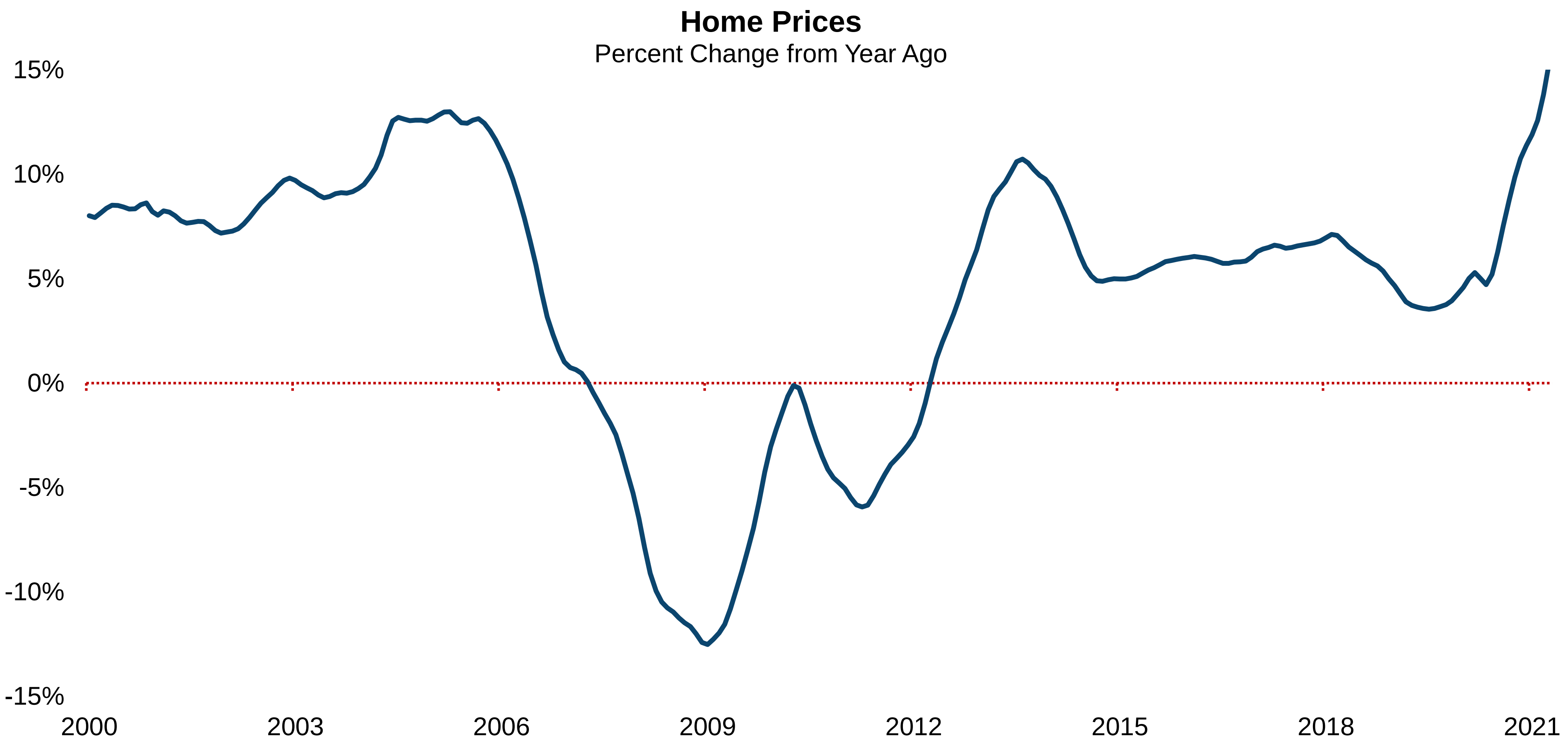


Number of Renter Households per Homes Available for Sale



Source: National Association of Realtors, U.S. Census Bureau and HVS.

Home Price Growth Is at the Highest Rate Ever

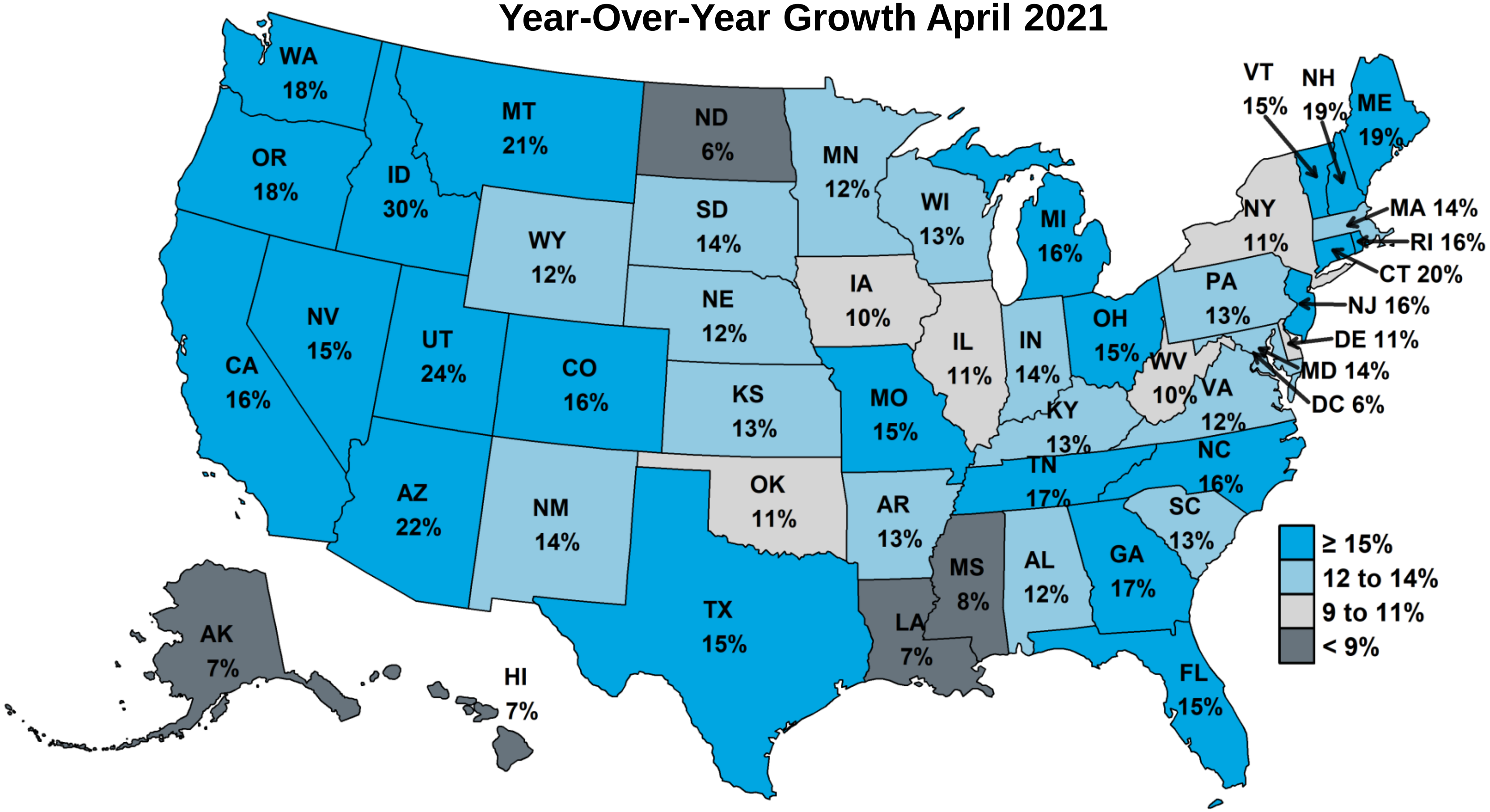


Source: FMHPI.

Home Price Growth Is Highest in Rocky West, New England and Coastal South

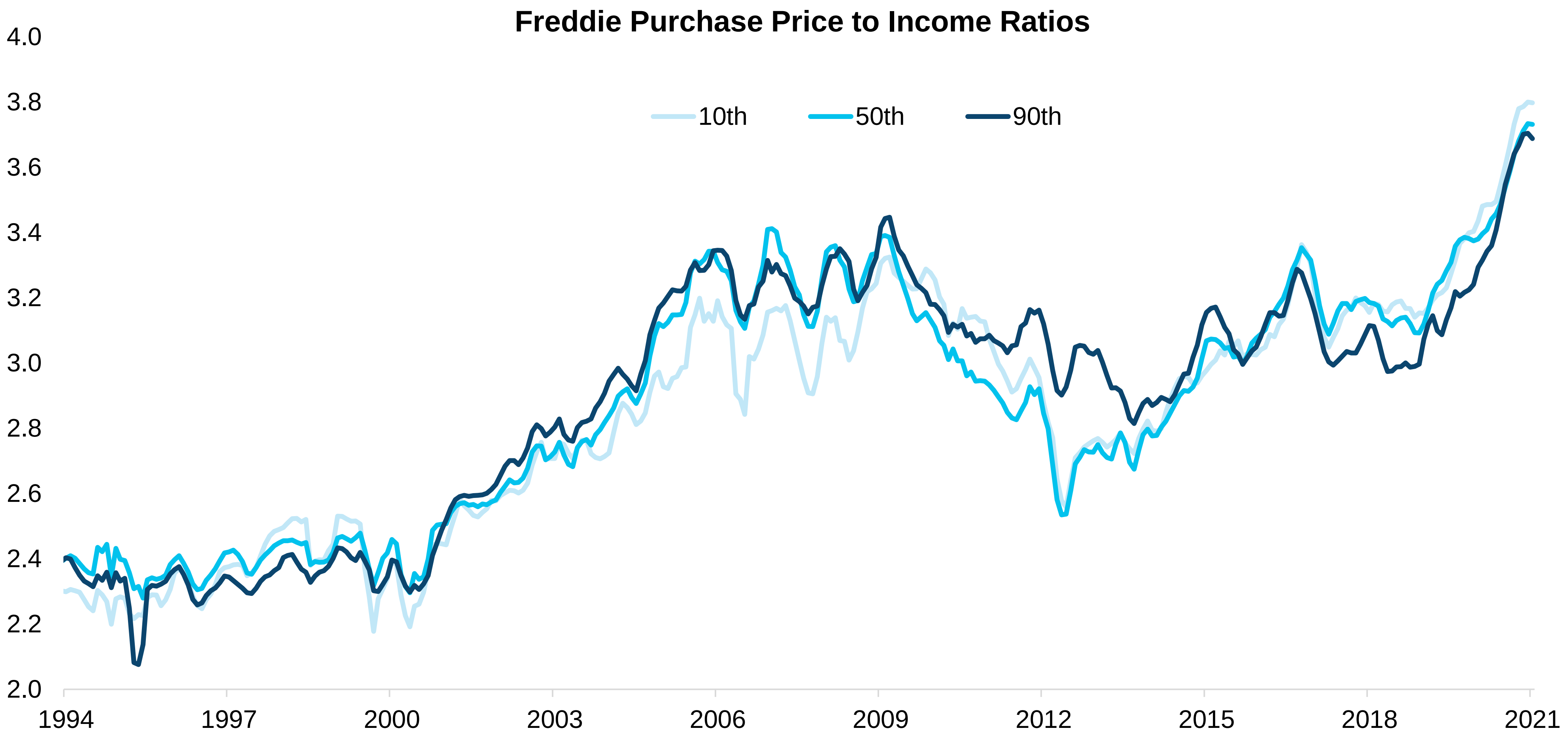
United States: 15.3%

Year-Over-Year Growth April 2021



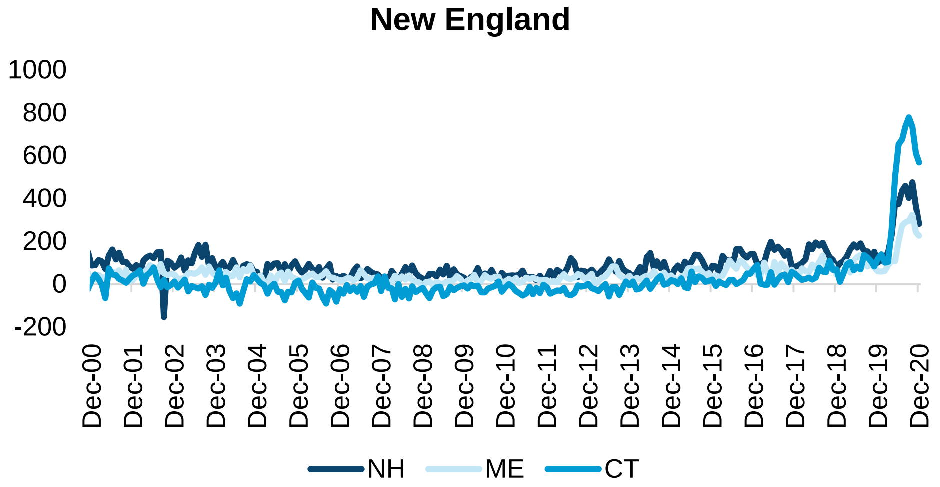
Source: Freddie Mac. Note: The Freddie Mac House Price Index for the U.S. is a value-weighted average of the state indexes where the value weights are based on Freddie Mac's Single-Family credit guarantee portfolio. Other indices of home prices may have different results, as they are determined using different pools of mortgage loans and calculated under different conventions. The Freddie Mac House Price Index for the U.S. is a non-seasonally adjusted monthly series. Percent changes were rounded to nearest whole percentage point.

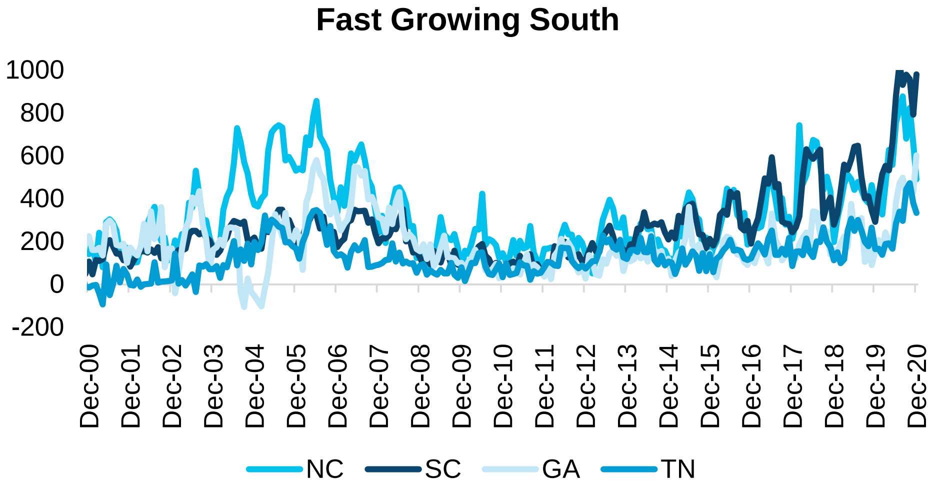
Freddie Mac Purchase Price to Income Ratios Soared During Pandemic

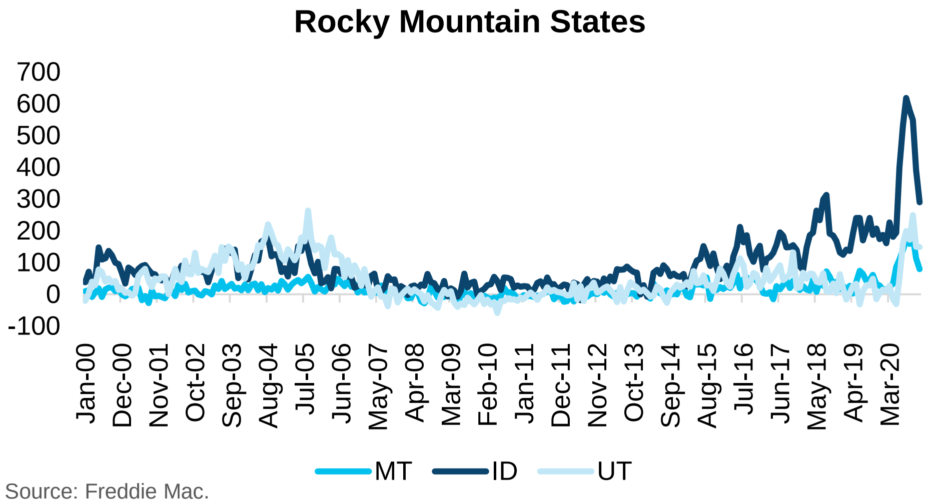


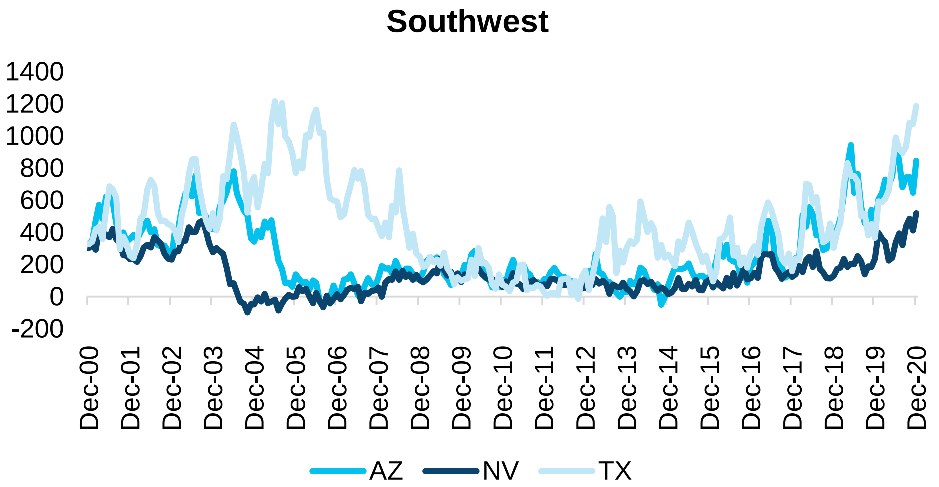
Source: Freddie Mac.

Homebuyers Are Migrating to New England, Fast Growing South, Southwest and Rocky Mountain States



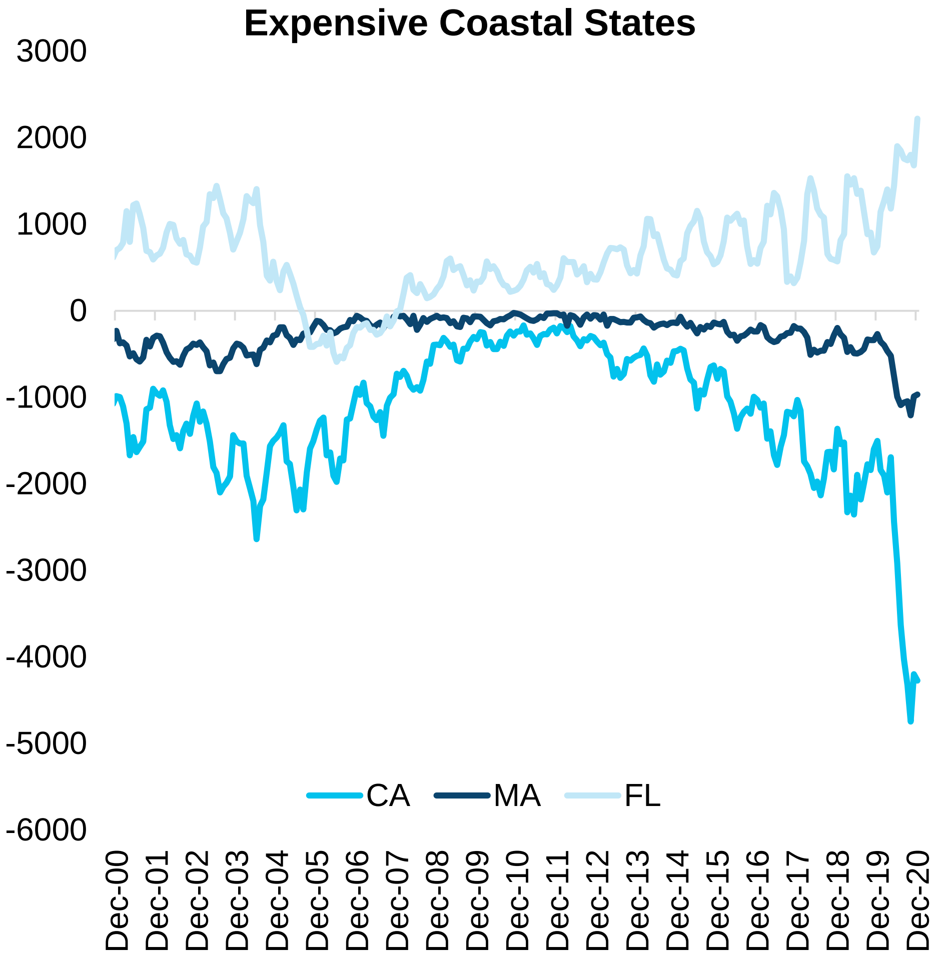


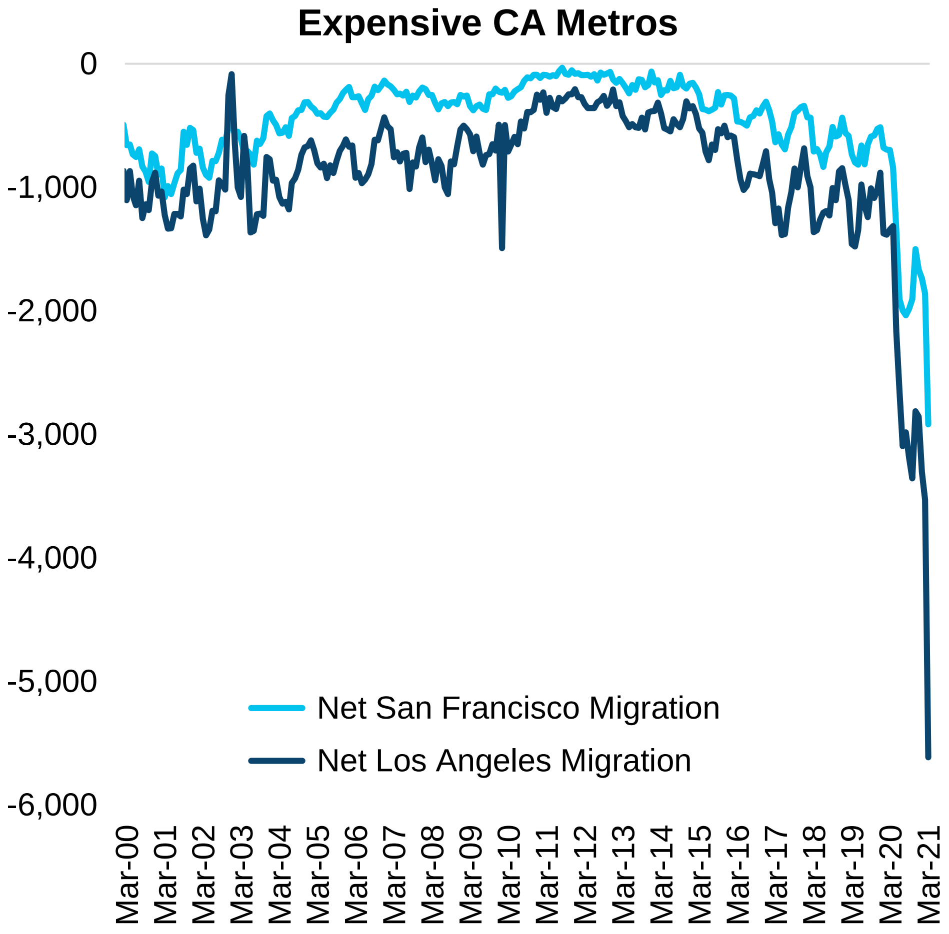




Source: Freddie Mac.

Homebuyers Are Fleeing Expensive Coastal Markets Like CA and MA While Florida Still Growing Due to 50+ Migration

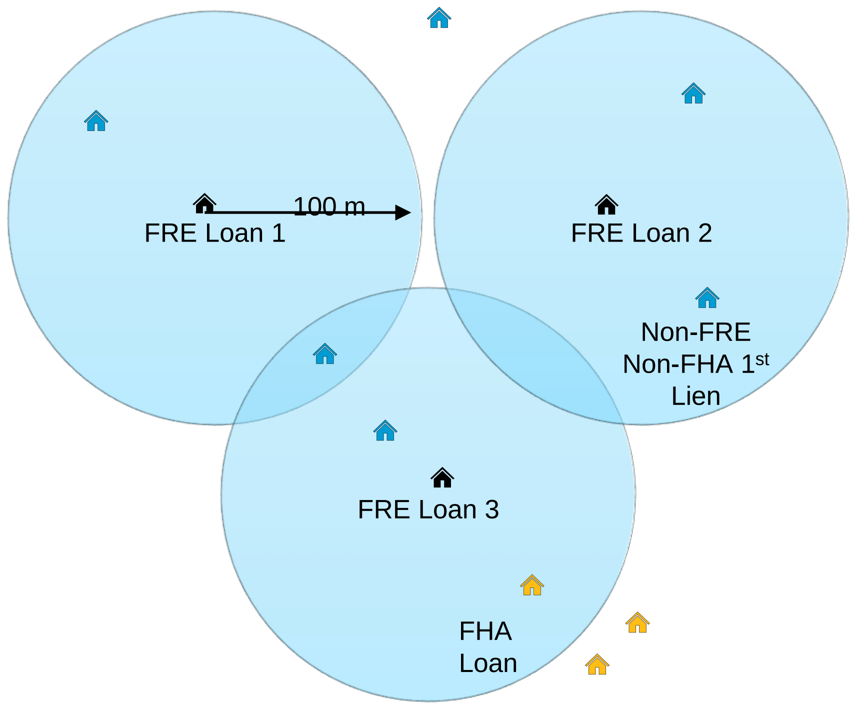




Source: Freddie Mac.

FHA 'Proximity Share' to Freddie Mac Properties Is Half the Overall FHA Market Share

Proximity Share Definition



FHA Share of Mortgages

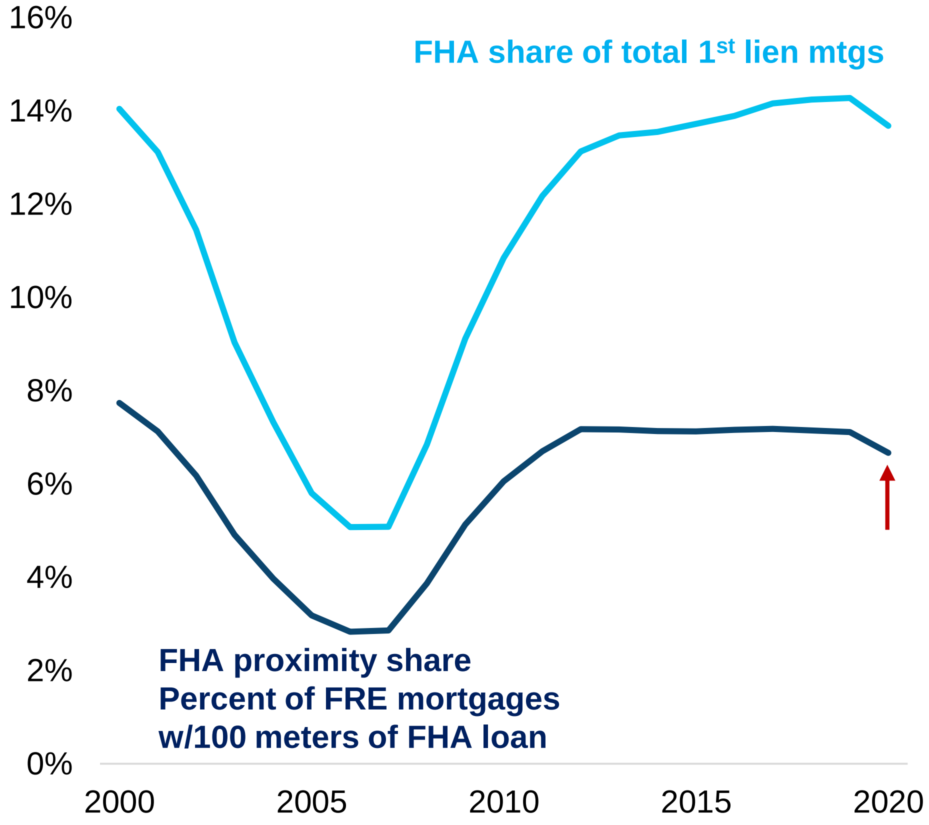
3 ÷ 12 = 25%

FHA Proximity Share of Mortgages

8%

Percent of FRE mortgages w/ 100 meters of FHA loans

Top 20 Markets



Source: Freddie Mac analysis of the top 20 markets and CoreLogic.

Recent, Current and Forthcoming Research

- US Population Growth, Where is Housing Demand the Strongest (Feb)
- A Detailed Look at Forbearances (Feb)
- 2020 Refinance Trends (Mar)
- Decline in Entry-Level Supply and Housing Supply Deficit (April/May)
- Minority Refinance Trends and Opportunities (May)
- Changes in Spatial Demand, City vs Suburb (Forthcoming)

FreddieMac.com/Research

@TheSamKhater

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Virtual Event Series 2021

Credit Risk Management Overview

Terri Merlino

Senior Vice President and Chief Credit Officer, Single-Family Business

Tuesday | June 8 | 2021

Single-Family Credit Risk Management

Credit Risk Management

- **Counterparty Credit**: Approve/terminate clients, monitor financial and operational performance
- **Credit Policy**: Define, implement, and manage Credit Policy including negotiated credit terms of business
- **Automated Underwriting Risk Assessment**: Use automation, insights and collaboration to drive innovative intelligent credit risk assessments
- **Quality Control**: Enable reliable measure of credit quality
- **Analytics, Reporting, and Transactions**: Establish benchmarks for acceptable loan quality and performance. Define the acceptable risk boundaries associated with mortgage credit
- **Client Credit Management**: Allow clients to operate within our risk appetite while meeting credit demands. Monitor Seller performance compared to established benchmarks

Trusted partner in support of business objectives
and operational effectiveness of Freddie Mac's Single-Family business

The 3 Cs

Credit

In this context, credit refers to a borrower's ***willingness*** to repay the loan. Factors that determine credit include:

- Credit score
- Foreclosures and bankruptcies
- Mortgage delinquencies
- Repossessions and collections

Capacity

Capacity refers to a borrower's ***ability*** to repay the loan. Factors that determine capacity include:

- Monthly housing expense-to-income ratio
- Debt payment-to-income ratio
- If the borrower is salaried or self-employed
- Cash reserves
- Loan Characteristics

Collateral

Collateral refers to ***property*** used to secure the loan. Factors that determine collateral include:

- Borrower's total equity or down payment
- Property type (e.g., 1-unit, condominium)
- Property use: (e.g., primary residence, second home)

Our Platform

Automated Underwriting Risk Assessment

Pre-Qual/ Application → Processing/ Underwriting → Pre-Closing → Closing

Loan Product Advisor®
Enhanced Underwriting Workflow

- Risk Assessment
- Purchase Eligibility
- Collateral Options (ACE)
- Asset & Income Modeler (AIM)

Loan Quality Advisor®
Eligibility Evaluated

- Risk Assessment
- Purchase Eligibility
- Loan Data Compare
- Confirmation of R&W Relief

Loan Collateral Advisor®
Accurate Evaluations

- Collateral Risk Scoring
- Collateral R&W Relief
- Appraisal Quality Messaging
- Comp Analysis

Condo Project Advisor®
Determine Viability

- Unit-level exception tool

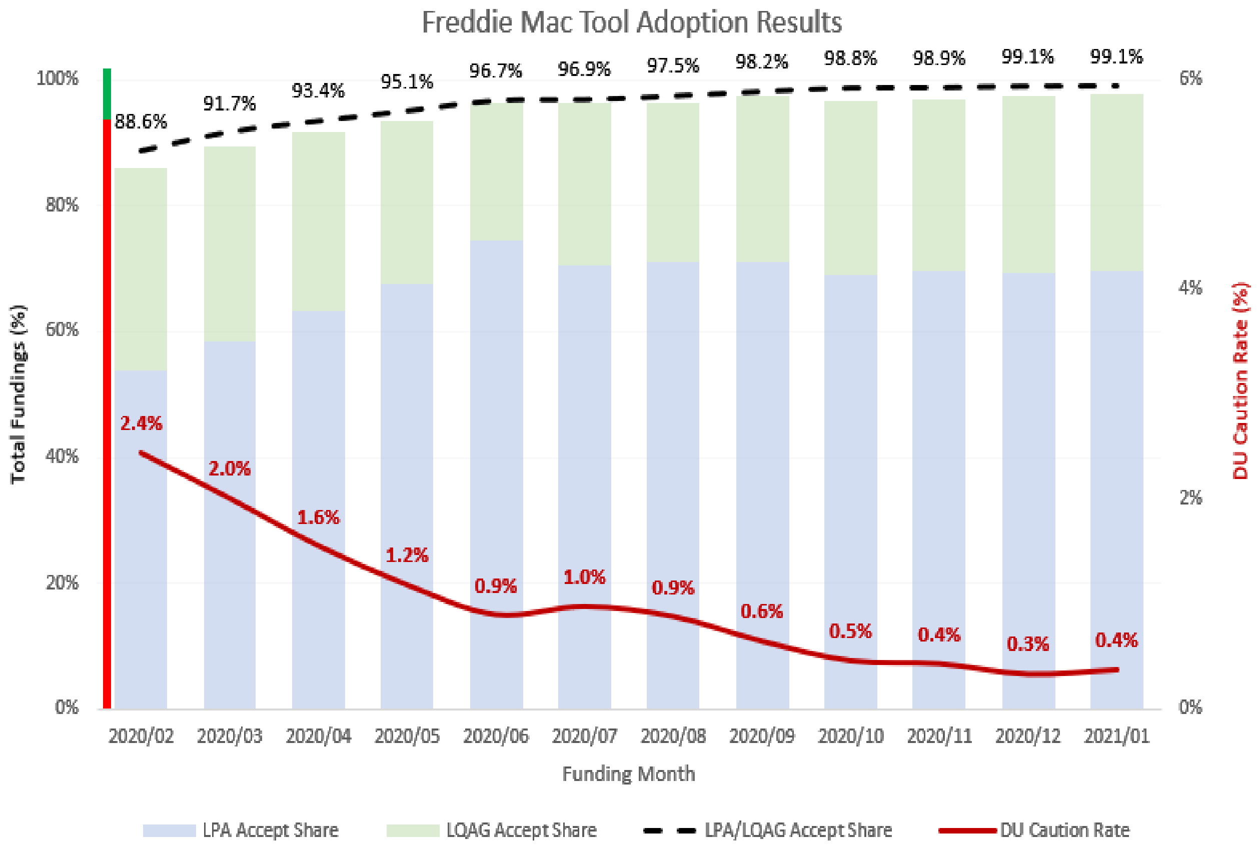
Automated Underwriting Tool Adoption

We are focused on requiring our risk assessments on all loans purchased by Freddie Mac.

- Loan Product Advisor® is Freddie Mac's proprietary automated underwriting system; loans evaluated through LPA comprise 70% of January 2021 deliveries (excluding HARP loans).

- As we moved towards only accepting loans evaluated by our tools, we deemed 99% of loans acceptable in January, maintaining a rolling 12-month peak. Thereby, decreasing the portion of unfavorable Desktop Underwriter® (DU) loans from 3% at the start of 2020 to only 0.4%.

- As of March 1, 2021 Loan Selling Advisor will be updated to prevent loans that have not been evaluated by our tools from being delivered to Freddie Mac.

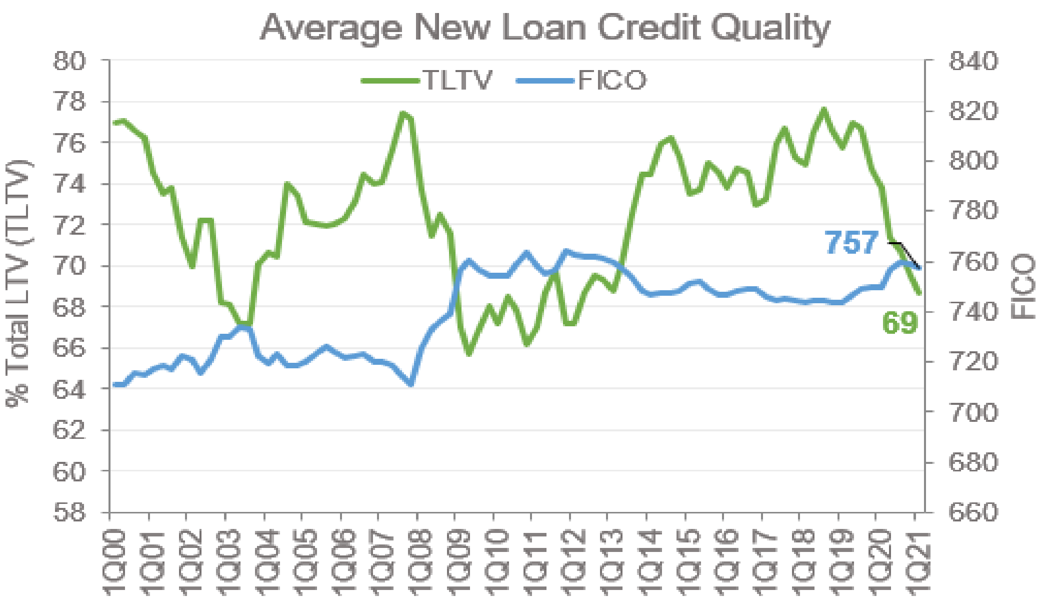


Portfolio Credit Quality Remains Strong

- Despite the severe impact of COVID-19, the average credit quality continues to strengthen. Risk tails have improved since early 2019 as credit quality has tightened and the market has shifted toward refinances.

All Flow Loans

	2016	2017	2018	2019	2020	1Q 21
Millions of Loans	1.6	1.4	1.3	1.7	3.8	1.2
Funded $ Billions	373	332	299	427	1,085	360
FICO <680 Loan Share	8%	9%	10%	8%	5%	5%
TLTV >90 Loan Share	15%	18%	22%	20%	12%	8%



Home Possible and Home Possible Advantage combined into a single offering in 2019.

COVID–19 Pandemic Response

Notable Policy Actions

Flexibilities with Notice Of Discontinuance

- Collateral Flexibilities: Permitted the use of exterior-only inspections and desktop appraisals for mortgages with certain characteristics, added flexibility to our completion report by allowing the use of a borrower certification of completion.
- 10-Day Pre-Closing Verification: Flexibility to use an email directly from the employer's work email address, a YTD paystub from the pay period immediately preceding the Note Date, or a bank statement with payroll deposit immediately preceding the Note Date.
- Condominium Projects - Exempt from Review: Temporary flexibility allowed. Exempt from Review eligibility up to 90% LTV/TLTV/HTLTV for Freddie Mac owned "no cash-out" refinances (Primary Residence only). This will revert to Guide, which is 80%.
- Previously Discontinued: Delivery of Mortgages in Forbearance.

Moved To The Guide

- ACE Eligibility: Extended eligibility of ACE appraisal waivers to include certain cash-outs and no cash-out refinance transactions.
- Representation and Warranty Framework: A mortgage in forbearance status may still qualify for relief of enforcement of reps and warrants if the payment history requirements are met.
- 10-Day Pre-Closing Verification: Email directly from the employer’s work email address.

The GSEs were aligned in the implementation of the temporary measures that helped support origination and underwriting activities while continuing to promote responsible lending as the COVID-19 situation evolved.

COVID–19 Pandemic Response (cont.)

Risk Management

- Age of Documentation: Most income and asset documentation must be dated no more than 60 days prior to the Note Date.
- Eligibility Requirements for Borrowers With Existing Mortgages: The borrower is either current on their mortgage, or if the mortgage was in a repayment plan, deferral, or any other loss mitigation program the borrower must make at least three consecutive timely payments prior to the Note Date of the new mortgage.
- Stocks, Stock Options and Mutual Funds: Evidence of liquidation is required when the funds are needed for down payment and/or closing costs.
- Self-Employed Borrowers: Seller must confirm the borrower's business is open and operating within 10 days of the Note Date. Additionally, we added new documentation requirements for establishing income stability.
  - An unaudited YTD P&L plus two months business bank statements or an audited YTD P&L is required.

Counterparty Credit

- Continuing to closely monitor limits, exposures, and financial condition of counterparties and COVID-19 impact on Servicing.

We continue to provide stability and liquidity to the market.

Preferred Stock Purchase Agreement (PSPA)

- On January 14, 2021, the FHFA entered into a letter agreement with the U.S. Department of the Treasury (Treasury) to amend the PSPA between Freddie Mac and Treasury.

Equitable Access to the Secondary Market

Provide Small Lender Protections

- We cannot vary the pricing or any other term of the acquisition of a Single-Family loan based on the size, charter type or volume of business of the seller of the loan.
- We are required to:
  - Purchase loans for cash consideration.
  - Operate the cash window with non-discriminatory pricing.
  - Beginning on January 1, 2022, limit the volume purchased through the cash window to $1.5 billion per lender during any period comprising four calendar quarters.
  - Comply with directives, regulations, restrictions, or other requirements prescribed by FHFA related to equitable secondary market access by community lenders.

Acquisition of Certain Loans

Investment Properties and Second Homes

- Acquisition of second home and investor property mortgages are limited to 7% of acquisitions for the preceding 52-week period based upon acquisition unpaid principal balance (UPB).

Mortgages with Layered Risk

- Mortgage deliveries with at least two high risk characteristics, defined as < 680 credit score, DTI >45% and LTV >90% are restricted:
  - Purchase transactions are limited to 6% UPB.
  - Refinance transactions are limited to 3% UPB.

Qualified Mortgage (QM)

- A QM mortgage, is a mortgage where the lender has determined the borrower has the ability to repay the mortgage.

We are continuously monitoring and evaluating the actions necessary to manage compliance with the amendment, while meeting our regulatory obligation to reduce risk.

Preferred Stock Purchase Agreement (PSPA)

Actions taken to manage compliance with the restrictions announced in the amendment:

- **Guide Bulletin 2021-11 announced we will no longer purchase mortgages secured by investment properties or second homes that are not Loan Product Advisor mortgages with a Risk Class of Accept.**
  - Manually underwritten mortgages secured by investment properties or second homes are not eligible for sale to Freddie Mac.
  - Investment properties and second homes submitted to Loan Quality Advisor will receive a Risk Assessment result of “Yellow – High Likelihood of Caution” and will be ineligible for sale to Freddie Mac.

- **Guide Bulletin 2021-13 provided updates to mortgages eligible for sale to Freddie Mac.**
  - All mortgages subject to the Revised QM Rule must be originated under the requirements of the Revised QM Rule to meet the Freddie Mac Guide requirements.
  - Mortgages originated using the GSE Patch may not be sold to Freddie Mac if they are subject to the Revised QM Rule and do not meet its requirements.
  - Government loans that meet the QM requirements for “other agencies” in the CFPB’s Revised QM Rule remain eligible for sale to Freddie Mac.

Freddie Mac
Single-Family

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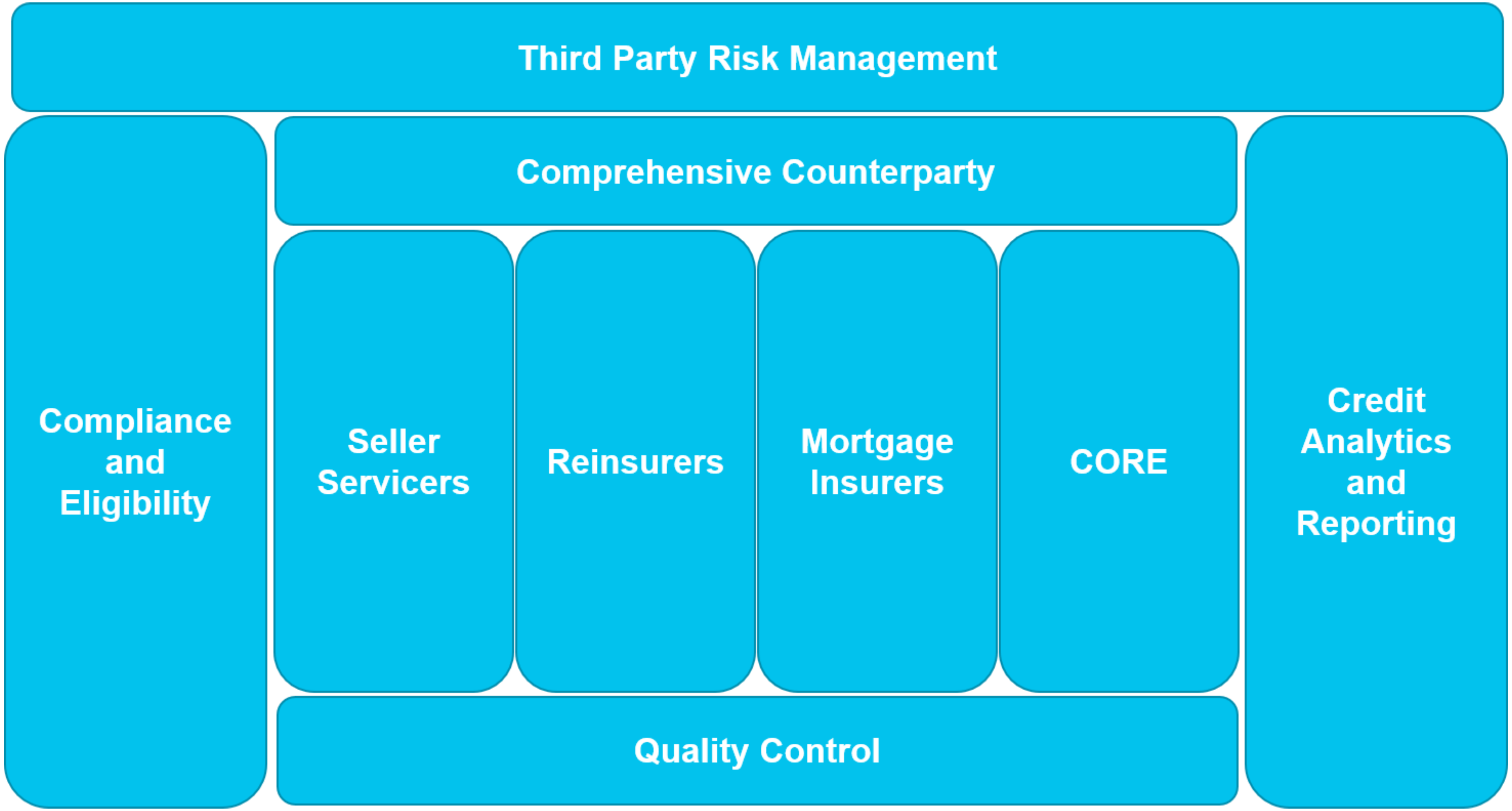
Counterparty Credit Risk Management

Katie Shilinsky

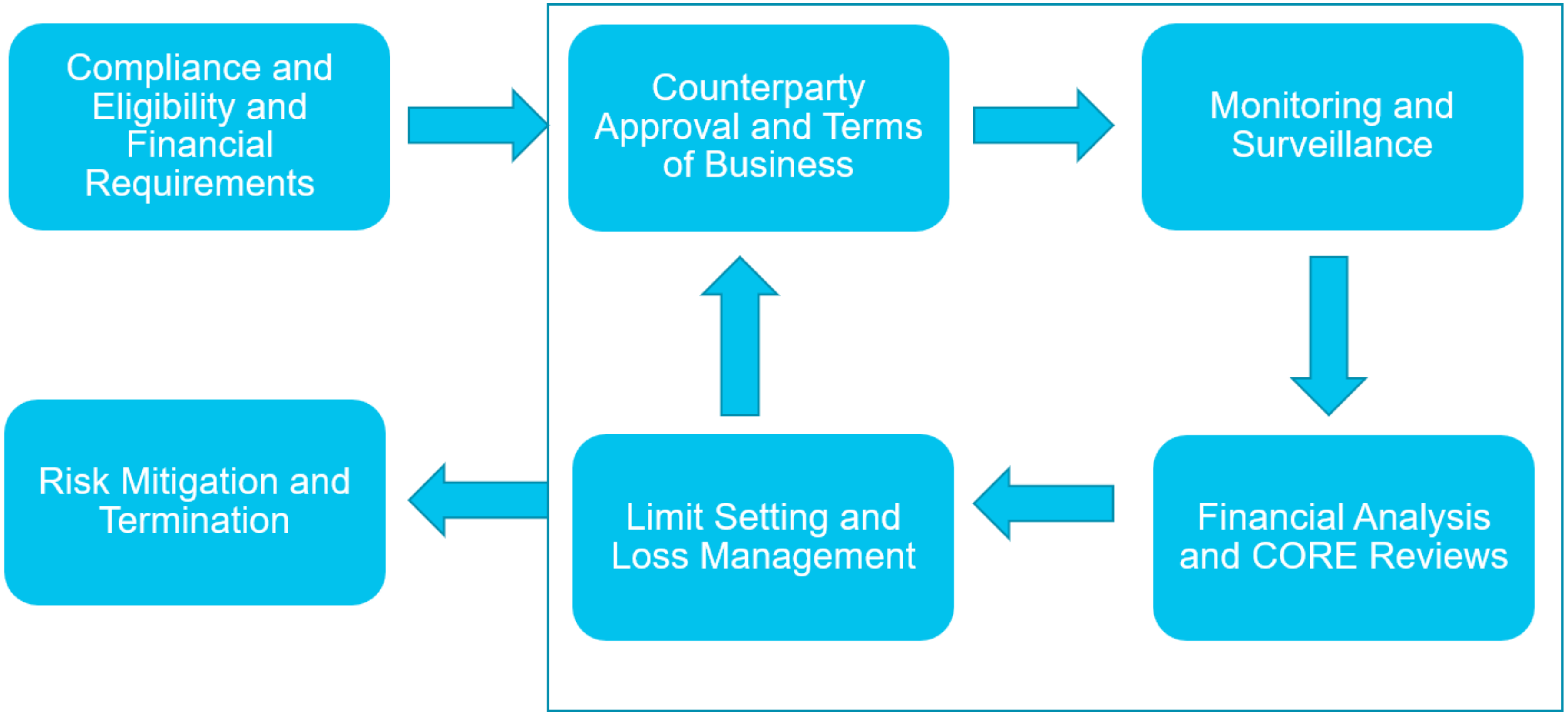
Vice President, Single-Family Counterparty Credit Risk Management

Tuesday | June 8 | 2021

Expanded View of Counterparty Risk Family



Counterparty Life Cycle



Performance of a counterparty life cycle is managed by our people and platform

Counterparty Risk Management Overview: Holistic Risk View

Institutional credit risk appetite
- Risk appetite thresholds based on stressed loss of the portfolio and board limit
- Stressed Loss incorporates the probability of counterparty default, loss given default, and exposure at default
- Thresholds are reviewed at least annually

Risk rating and management limit
- Risk rating generated by scorecard and/or in-depth financial review
- Management limit determined by risk rating and the size and type of counterparty; measures against stressed loss upon default which includes probability of loss recovery
- Management limit set below the board limit to give cushion
- Risk ratings and management limits are reviewed periodically

Monitoring and reporting
- Monthly KRIs and KPIs such as changes in loss given default rate and deterioration of risk rating
- Monthly management reporting for high-risk counterparties may trigger deep dive credit reviews or adverse action
- Policies for various activities counterparties may pose risk
- Collaboration across business areas for compressive counterparty view

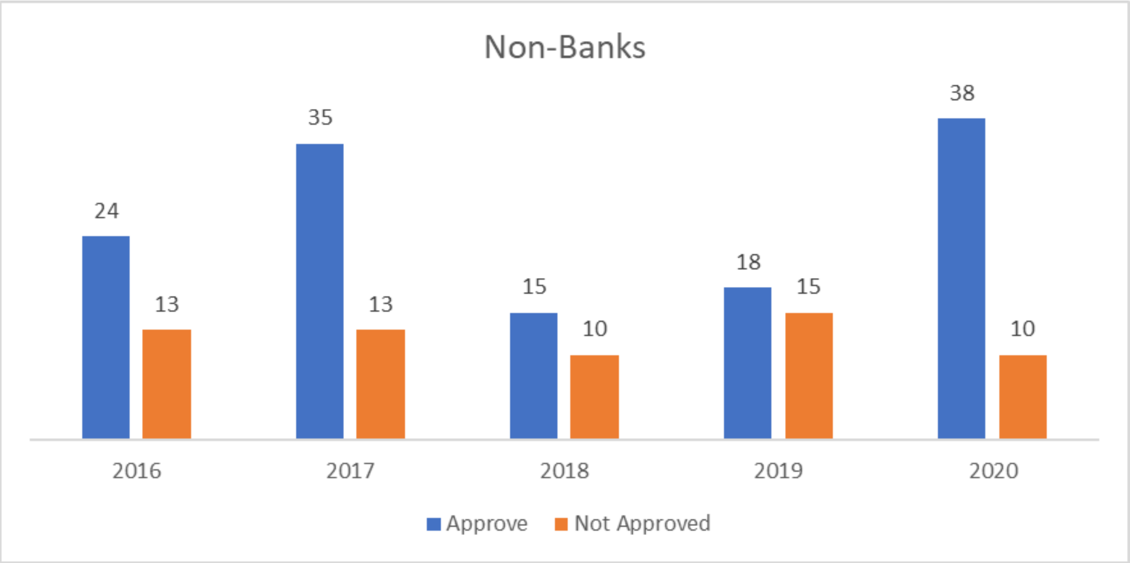
Complete risk view
- Bring together all risk types
- Governance process brings all risk types together to understand the potential impact of nonfinancial risks
- Holistic risk view ensures appropriate strategy alignment

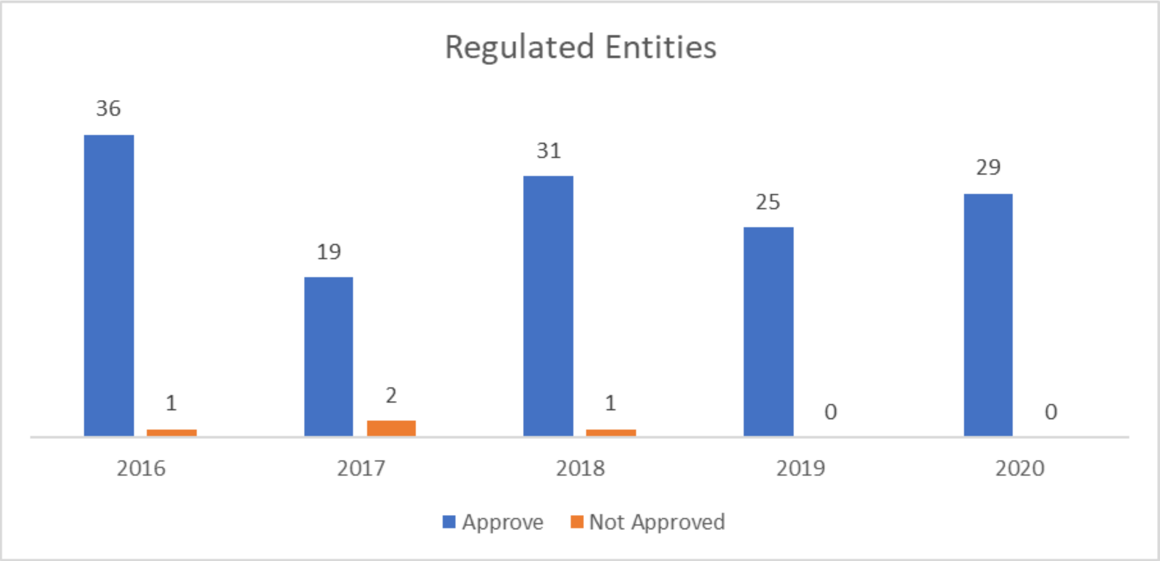
Enhanced risk management process to ensure understanding and alignment of all risks facing our counterparties.

A robust and effective management framework, which has repeatedly prevented losses

New Seller / Servicer Application Approval

Trends in the Rate of Approvals and Declines





- Record volume of applications reviewed in 2020. We expect application volume will remain elevated in 2021 as origination market remains favorable and more originators seek direct access to liquidity.
- Approval rate improved in 2020 for non-banks but remained similar for regulated entities. Our credit standard continues to focus on transacting with counterparties of healthy financial conditions, strong financial and operational controls, and sound business strategies. Our credit assessment of non-banks strengthened as we took in considerations of market events in the first half of 2020.
- Non-banks that were not approved in 2020 were due to weak historical performance, unproven business models, inadequate controls around financial reporting, inability to meet minimum financial standards, or legal issues that imposed reputational risk to Freddie Mac.

Minimum Financial Requirements

Requirement	Current	Proposed
Minimum Net Worth	$2.5 million + 25 bps of UPB for total 1-4 unit residential mortgage loans serviced	$2.5 million + 35 bps of UPB for Ginnie Mae Servicing + 25 bps of UPB for all other 1-4 unit residential mortgage loans serviced
Minimum Capital Ratio	Tangible Net Worth / Total Asset >= 6%	Tangible Net Worth / Total Asset >= 6%
Minimum Liquidity		
Base Liquidity	3.5 bps of Agency Servicing UPB	4.0 bps of Enterprise servicing UPB + 10bps of Ginnie Mae servicing UPB
NPL Threshold	Agency NPL > 6% requires an incremental NPL charge.	Agency NPL > 4% requires an incremental NPL charge.
Incremental NPL Charge	+ an incremental 200 bps charge on Agency NPL for the portion of Agency NPL > 6.0% of Agency servicing.	+ an incremental 300 bps charge on Agency NPL for the portion of Agency NPL > 4.0% of Agency servicing.
Allowable Assets for Liquidity	Cash and Cash Equivalents (Unrestricted) Available for Sale (AFS) or Held for Trading (HFT) Investment Grade Securities: • Agency MBS • Obligations of GSEs • US Treasury Obligations Unused/available portion of committed servicing advance lines of credit.	Cash and Cash Equivalents (Unrestricted) Available for Sale (AFS) or Held for Trading (HFT) Investment Grade Securities: • Agency MBS • Obligations of GSEs • US Treasury Obligations [Remove from list of Allowable Assets] ~~Unused/available portion of committed servicing advance lines of credit.~~

- Proposed minimum financial eligibility requirements provides further transparency and consistency of the capital and liquidity required for Seller/Servicers of different business model
- Addresses the risk factors related to servicing Ginnie Mae mortgage
- Incorporates Ginnie Mae guidelines for consistency in the marketplace
- Strengthen servicer financial capacity to in event of economic downturn
- Proposed standards will be effective December 31, 2020 – Halted due to COVID-19

Seller / Servicer Eligibility 2.1 is in process of being reviewed and will be available for industry comment in mid-2021

Financial Analysis

CCRM conducts “baseline” reviews of over 2,000 counterparties

- Deeper reviews are conducted using a risk-based approach
  - Annual review schedule (largest counterparties)
  - Quarterly reviews (risk-based selection)
- Automated quarterly rating and limit updates for all single-family counterparties

Reviews cover the following

- Affirm/change ratings and limits
- Approve terms of business
- Ensure compliance with policies and procedures
- Identify potential candidates for risk mitigating actions

Watchlist and Troubled Counterparty designation

- Automatic inclusion defined by specific criteria
- Management may also add a counterparty based on judgment

Financial Analysis

Surveillance tools include (but are not limited to):

- Monitoring of stress loss versus limits (including sub-limits)
- Periodic financial analysis (early warning tools)
- Monitoring of changes in internal and external risk ratings
- Coordinating with other business leaders / market information
- Monitoring of operational performance

Increased focus on industry trends and how market changes are impacting our banks versus non-banks

Limit Setting and Loss Mitigation

Risk appetite based on stress loss

- Allows FRE to monitor potential loss and account for collateral

Continue to refine our Probability of Default tools for better prediction of default within our segmented populations

- New tools allow us to more accurately monitor our portfolio
- Tools and models keep the customer experience in mind
- Allow for transparency to the client and other internal stakeholders

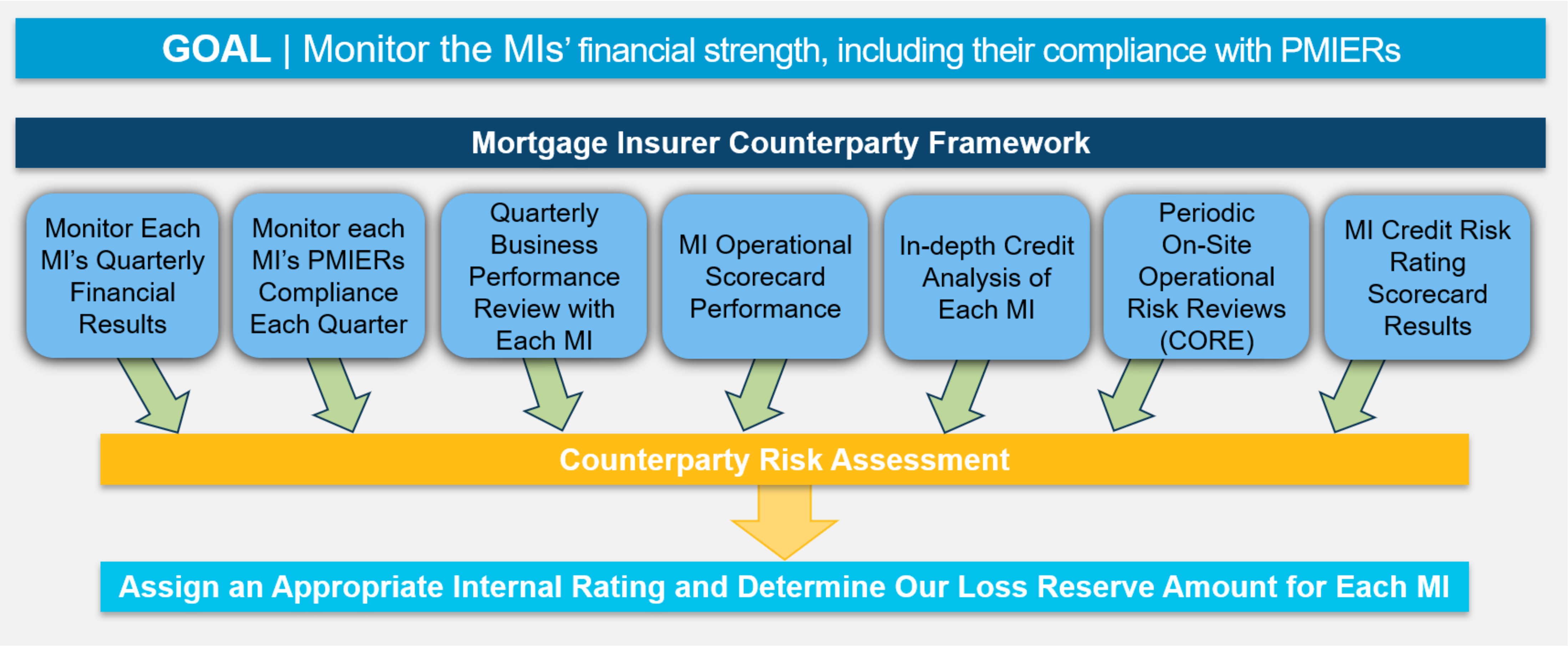
Management limits for internal monitoring

Counterparty Eligibility Requirements for Mortgage Insurers (PMIERs)

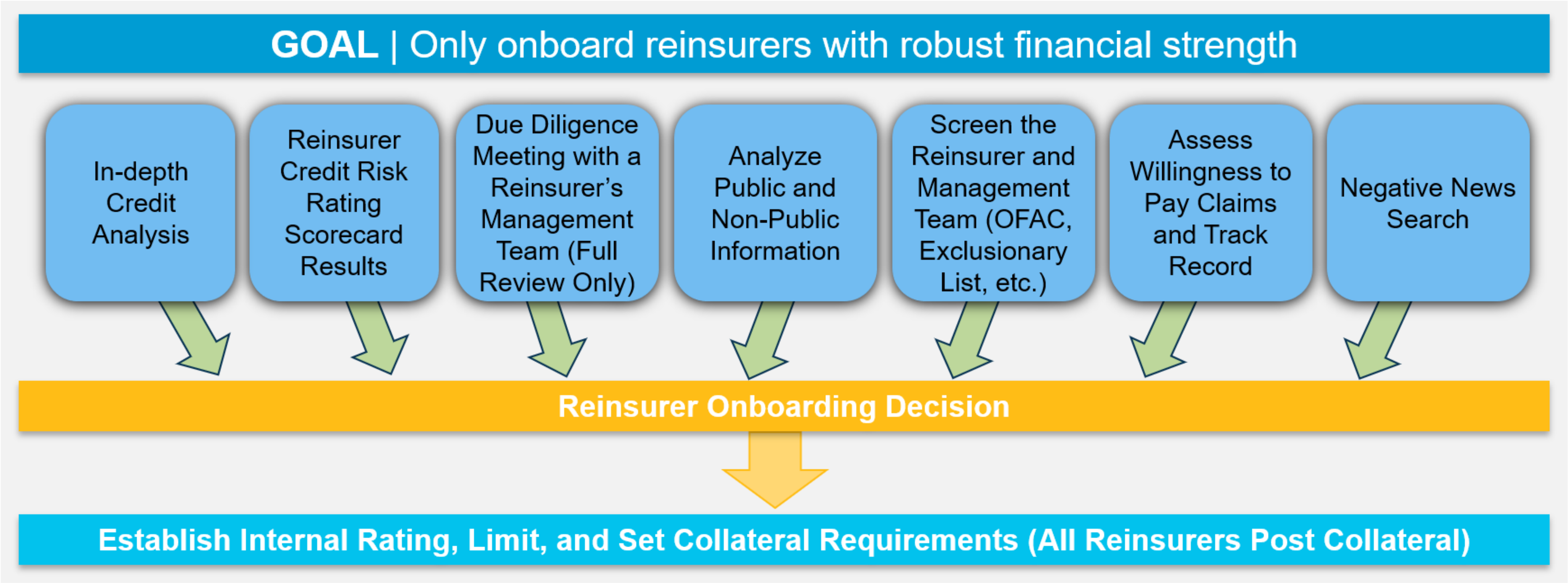
Private Mortgage Insurer Eligibility Requirements (PMIERs) 2.0

- Effective March 31, 2019
- Further improves the required quality of MIs' PMIERs capital by:
  - Eliminating the inclusion of premium credit for legacy loans and proceeds from debt and by
  - Limiting proceeds from surplus notes
- Established counterparty haircuts for risk transferred to third-party reinsurers
- Improved alignment of quality control requirements with GSE standards and mortgage insurance rescission
- Under PMIERs 2.0, most of mortgage insurers have a surplus of approximately $1B above the minimum requirement
  - Average surplus of the six mortgage insurers is $1.07B, which equates to the average mortgage insurer holding 41% more PMIERs available assets relative to the requirement

Mortgage Insurer Monitoring Framework



Reinsurer Onboarding Framework



Reinsurer Monitoring Framework

GOAL | Closely monitor our reinsurance counterparties' financial strength, limit utilization, and the overall level of our reinsurer counterparty concentration

- In-depth Credit Analysis of Each Reinsurer
- Reinsurer Credit Risk Rating Scorecard Results
- Identify Changes in Reinsurers' External Ratings
- Negative News Searches
- Monitor Limit Utilization and Forecast Future Utilization
- Calculate the Level of our Concentration to Our Panel of Reinsurers
- Use Dashboards to Monitor Potential Red Flags

Develop a view of the financial strength of our reinsurance counterparties, determine if any reinsurers are close to reaching their limit, and determine our overall level of counterparty concentration

Take action as appropriate, including adjusting internal ratings, collateral requirements, and limits

Investor Day
Virtual Event Series 2021

COVID-19 and Our Major Models

Michael Bradley

Senior Vice President, Single-Family Modeling and Analytics

Theme and Flow

Our major models are critically important to our overall success—these models allow us to scale massively and manage our $2.5T portfolio.

- COVID-19: Response and anticipated future loan performance.
- Robust models and resilient model processes.
- New capabilities and the models behind ACE and AIM.

COVID-19 and Our Major Models

Our major models continued to perform as expected during the pandemic (albeit sometimes with overlays) allowing us to continue to fulfill our mission and provide stability and liquidity to the market.

- Rate of forbearance has been less than expected—overshot with our overlays and have been dialing them back.
- From January 1, 2020 to March 31, 2021, 768K loans took FB.
- Among those exiting FB, 50% self-cured into current status or prepaid their mortgages; 41% took the Payment Deferral option; remainder miscellaneous options.

Additional Risk from COVID-19 Forbearance

- Built a new tool that monitors and analyzes all forbearance activity in the portfolio.
  - Track and monitor forbearance exits and how the various exit strategies perform over time.
- Developed a new type of mod to help borrowers who need assistance when exiting forbearance.
  - Payment Deferral: besides self-cure and prepayment, most borrowers take the option of payment deferral when exiting FB.
- Due to the FCL moratorium, very few loans have defaulted; only those that are vacant/abandoned are eligible to go to FCL sale.
  - Relying on various methods to model future COVID-related losses.
- Reviewed past loan performance during periods with high unemployment and rising home prices, focusing on geographies that had such an experience to help establish potential default/loss rates.
- Evaluated prior forbearance performance (during last crisis, disasters, and other periods) to further help refine our estimates.

Freddie Mac Single-Family

Investor Day
Virtual Event Series 2021

Building Robust Models and Model Processes that Are Resilient

Robust and Resilient Model Processes

"

Credit models for the last 10 years have undergone significant scrutiny and governance, driven by regulatory expectations and a determination that they are deemed 'fit for purpose' prior to their use. So why did they become 'unfit for purpose' in a matter of days?

E&Y COVID-19 Report

Financial institutions must now urgently review their model strategies. They need to develop and apply both efficient short-term actions and a long-term plan to improve model resilience."

McKinsey COVID-19 Report

"

Robust and Resilient Model Processes

PROBLEM STATEMENT

- Some of our major models needed significant overlays with the onset of the unprecedented COVID-19 pandemic.
    - Conventional sources of data became obsolete overnight.
    - The models with macro variables were most challenged, as broad policy actions are difficult to predict.
    - Fortunately, however, this is not true for all of our major models and this fact alone may paint a path forward.
- Relying on business overlays is less preferred than model-based alternatives.
- It's clear the Freddie Mac, and the profession generally, needs to adopt a broader view of model risk management with the goal of having models that perform well no matter what the circumstances.
- A path forward might be for us to focus on building models that are robust and model processes that are more resilient.

Problem with Macro Variables

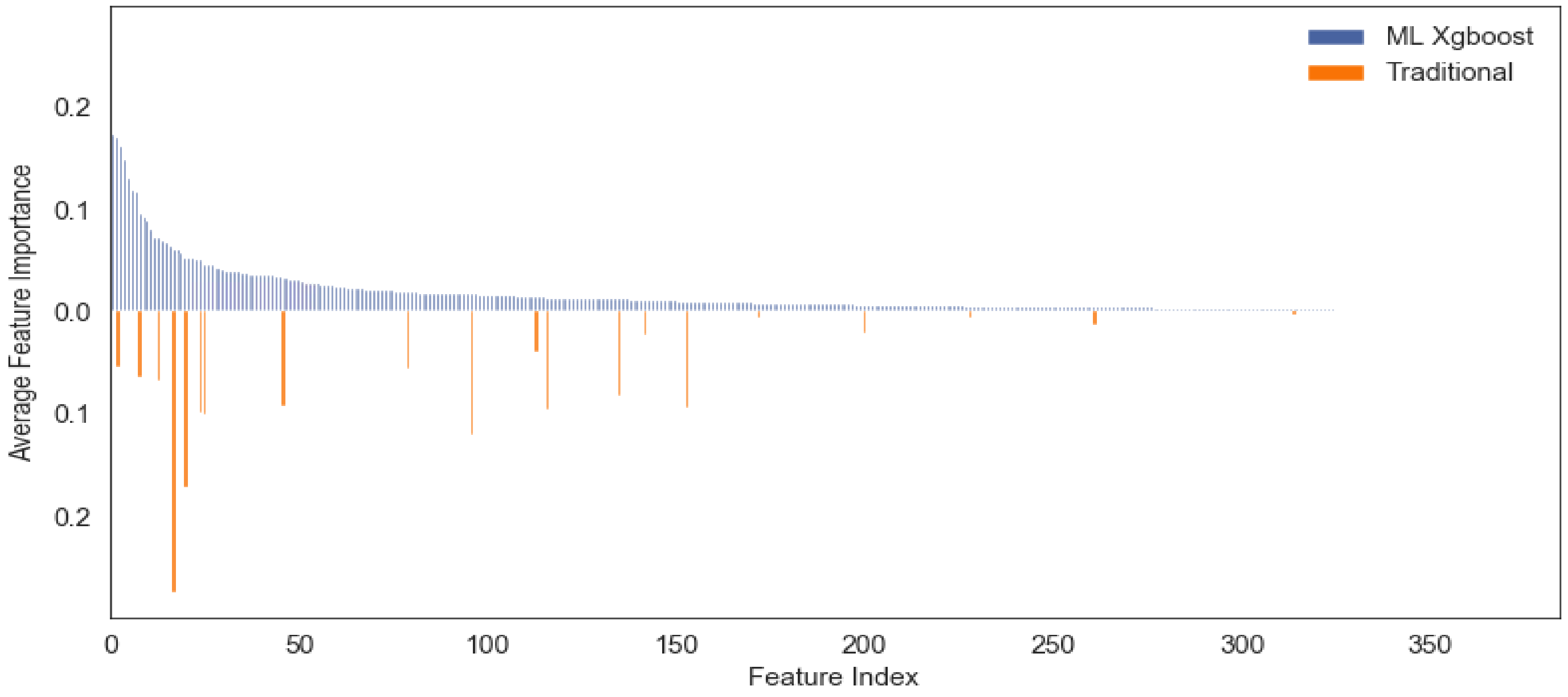
↑ Unemployment Rate

↓ GDP

↓ House Price Appreciation

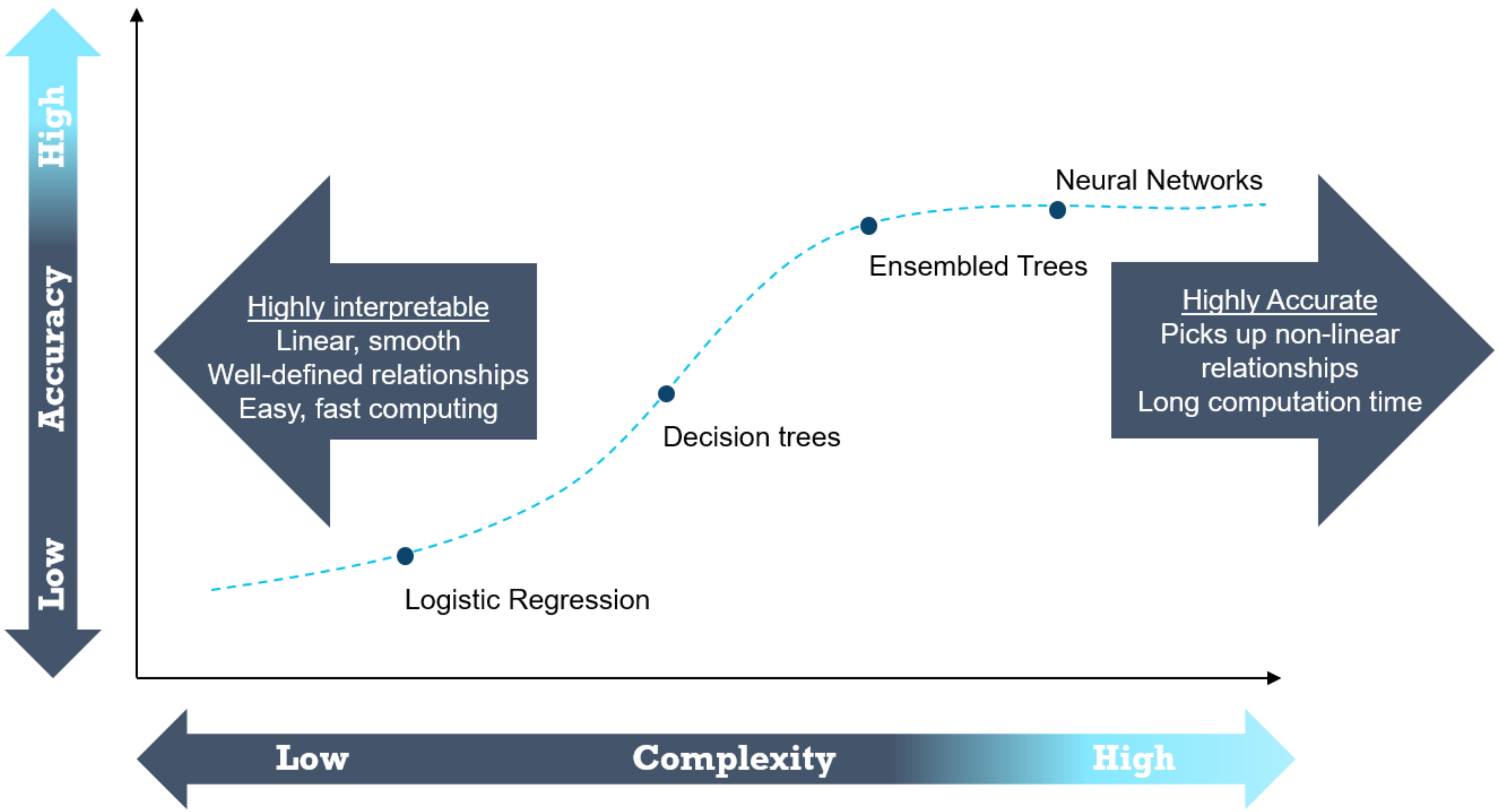
- More macro variables is NOT the answer!
- Need to rely on fundamental drivers, not proxies (e.g., real disposable not unemployment or GDP, net income not gross income).
- Machine Learning models continued to perform well.
- Need for robust models and resilient model processes.

Number and Importance of Features



The two models choose different variables, and for the overlapping variables, they weight them differently. Compared to the traditional model, no one variable has an as 'big' influence in the ML model.

Modeling Tradeoffs



Robust and Resilient Model Processes

BASIC DEFINITIONS

- Robustness is the ability of a system to avoid failure.
- Resiliency is the ability to recover from failure once it occurs.
- Both are essential elements of a good model risk management system.
- Nevertheless, there is little discussion of these properties.

BUILDING MODELS THAT ARE MORE ROBUST

- A few things might help us build models that are more robust:
  - Use of synthetic data and ‘adversarial examples.’
  - Reliance on more modern modeling techniques, e.g., concept drift.
  - Include fewer features in the models—making them less likely to break but also less optimal.

Robust and Resilient Model Processes

- But most of the big things that happen are ‘Black Swans’ and not anticipated.
  - My opinion is that it’s much more important to be able to nimbly respond once unanticipated things happen.
- Multiple views of models and ‘dials’ might be useful.
  - Examples: HPA using an AR model; stress and non-stress LPA.
- Greater emphasis on augmenting traditional data with inferences from alternative data sources.
  - Examples: Trended data, reservation data, closing data, MLS listings.
- Fully autonomous forecasting systems of the type discussed in *Resilient Neural Forecasting Systems,* Amazon Research (2020).
  - Interesting, but may not deal with ‘radical data distribution changes’ of the type associated with COVID-19.

Freddie Mac
Single-Family

Investor Day
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Advancing those Things that Worked:
A Few Machine Learning Applications

Natural Language Processing and Image Recognition

Modern Data Challenges, AI/ML and Business Solutions

Answering Biz Questions

Given recent CA ADU law, What is the ADU distribution across the country?

How often does discriminatory text exist in BPOs' property listing descriptions?

How many properties have home inspection report ordered compared to Appraisal report?

Volume

✓Property – Billions of records
✓Closing - Millions of records
✓BPO – Thousands of records

Variety

PDF
✓Property – Appraisal Report
✓UCD
✓Litigation Documents

XML
✓UCD

✓Property Images (Embedded)
✓MLS (Links to Property Images)
✓Condo – Documents

TXT
✓Property – MLS
✓UCD Fees
✓Policy Documents

CSV
✓Discriminatory Text Search (DTS)

✓DTS - BPOs
✓Vendor, MLS

Velocity

✓Daily, Weekly
✓Monthly, Annually

Data Management

Engineering & Technology

VMO

New / Existing

- 120+Tera bytes
- 10K tables

360^0

Data Assets for AI/ML

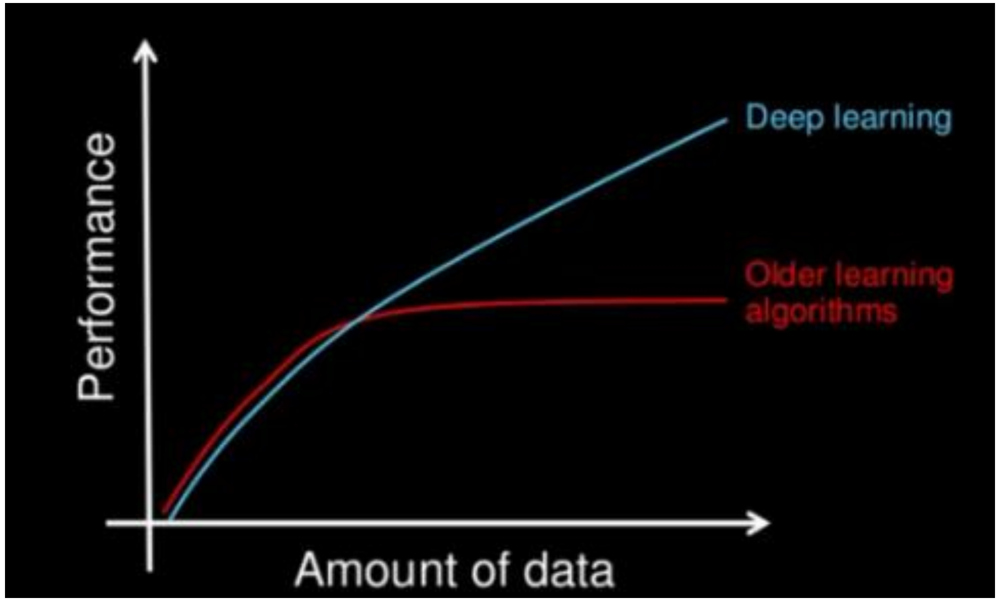
ML

NLP

Methodology and Comparison

Why Deep Neural Network over Traditional ML?

- Deep learning is a subset of machine learning that has networks capable of learning unsupervised from data that is unstructured or unlabeled. Also known as deep neural learning or deep neural network.
- Deep Learning has been proven to perform with great accuracy at scale when having to handle large datasets.
- Deep Learning really shines when having to deal with complex tasks like Image Classification, Natural Language Processing, and Speech Recognition.

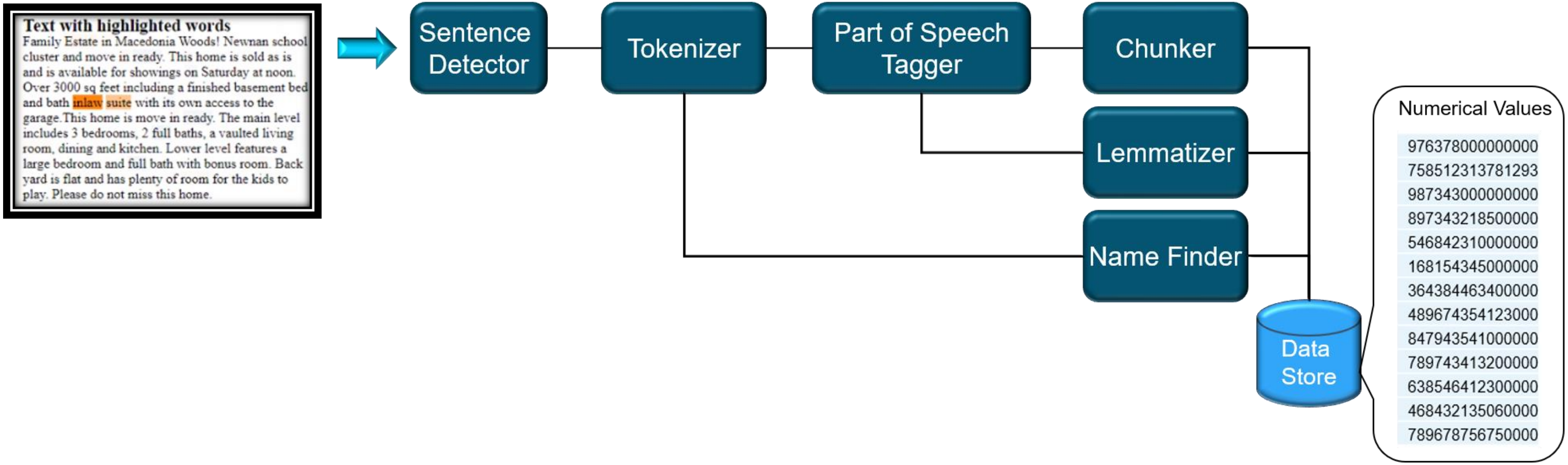


Build a generic text analytics and image processing framework.

Text Pre-Processing: NLP Framework

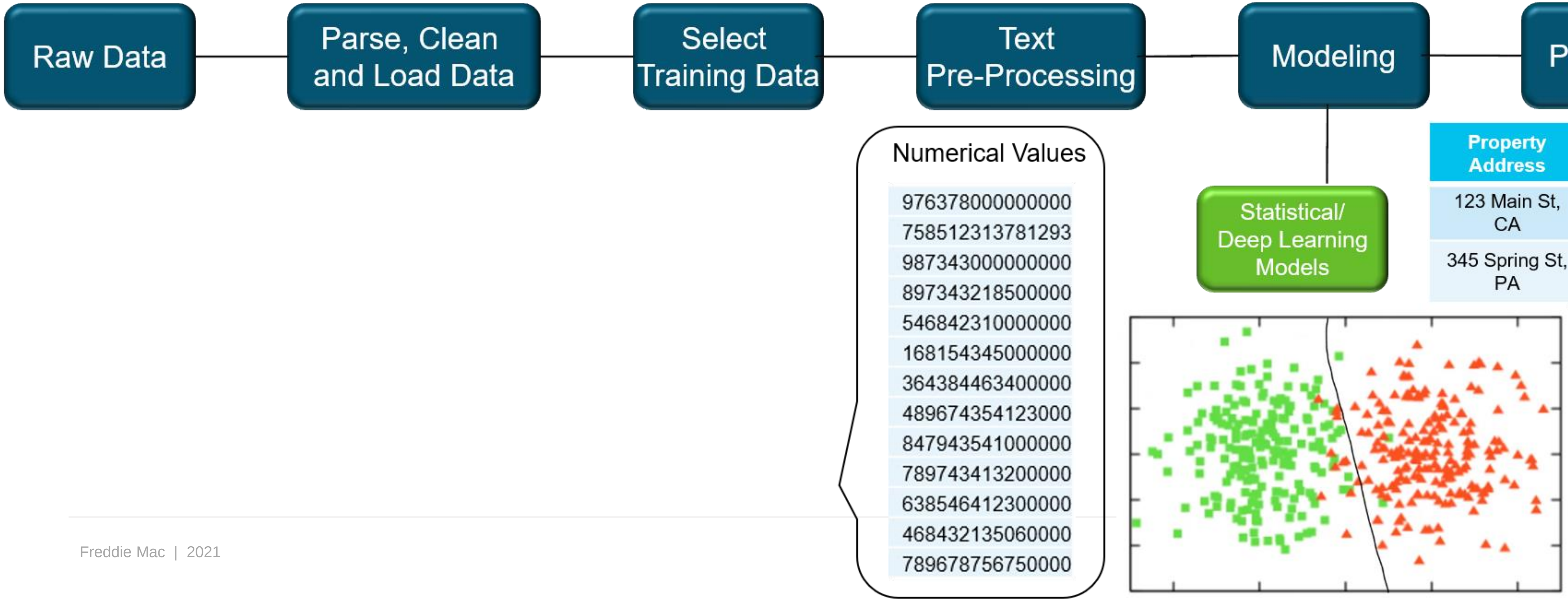
Text Pre-Processing

- Computers are designed to work with Structured data, follow well-defined Commands and use Standardized language.
  - Natural Language humans use is not structured. Computers require training to understand and work with Natural Language.
- With the power of Machine Learning, Computers can be taught Natural Language.
  - Multiple sets of text is fed to computers that is processed using text analyzer algorithms, which is how computer learns how to work with natural language.



Text Analytics: ADU

- ADU is a binary classification project. (Is it an ADU or not an ADU?)
- Only ADU examples were available. There were no examples of properties labeled as non-ADU available.
- We had an imbalanced data set with one class of examples. Training a model would make the model biased towards the ADU Class.
- Leveraged semi-supervised learning to generate non-ADU labeled data.
  - For ADU it could have taken 6 months for manual labeling, but with entropy based active learning it took 2 weeks.



Property Address	ADU Count	ADU Type
123 Main St, CA	2	In-law suite
345 Spring St, PA	1	Apartment

Computer Vision: Convolutional Neural Networks (CNN)

- Classify property condition based on image.

Appraisal Pictures

Preprocessing

Neural Network

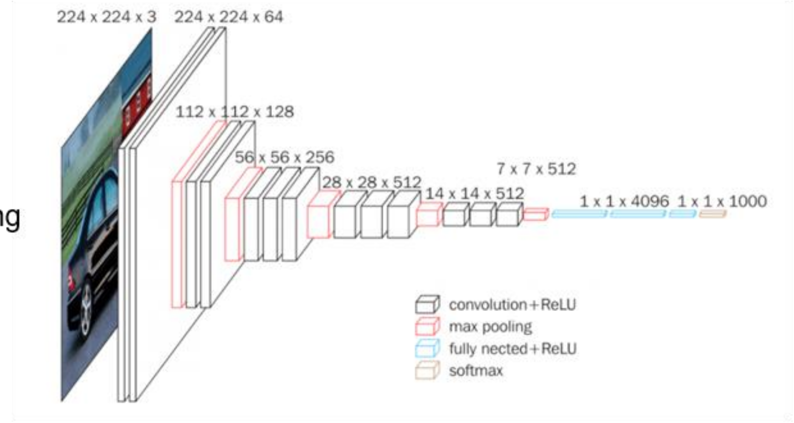


Image Classification

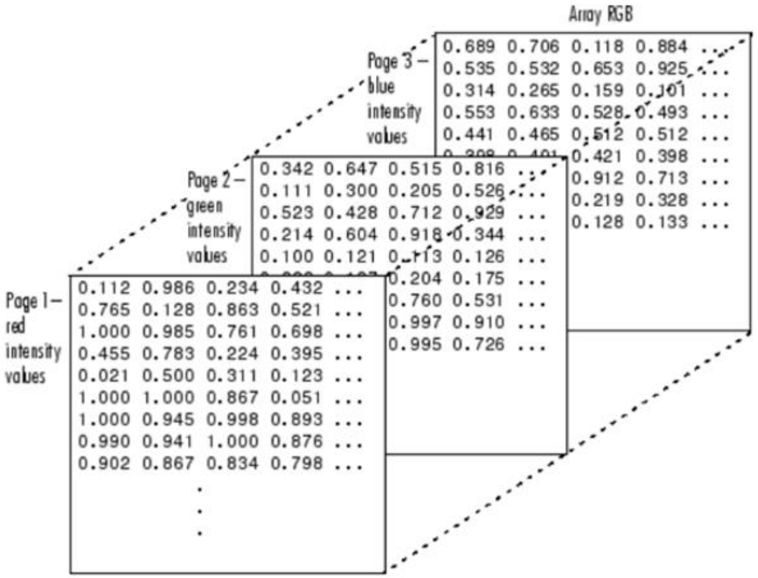
Property Features	Quality Rating
Room Type	Good
Floor Type	Poor
Kitchen SS Appliances	New
Kitchen Countertop	Upgrade
Cabinet	Upgrade
Exterior	Poor

Preprocessing steps:
- ✓ Morphological transformation (shape and size)
- ✓ Normalization (pixel value to same range)
- ✓ Augmentation (flip, rotate, crop, shift, rescale, zoom, fill etc.)

Computer Vision: Convolutional Neural Networks (CNN)

- Image classification model that uses CNN algorithm to determine the condition of property based on images.
- Type of training – Supervised (Label property condition to train the model. Model can then identify property condition).
- Meta Data – Labeled Images.

Raw Data — Parse/ Label — Extract PDF — Locate Images — Image Processing/ Labeling — Modeling — Business Value



What computer understands

Deep Learning Models (Supervised Training)

Data Store

Property Features	Quality Rating
Room Type	Good
Floor Type	Poor
Kitchen SS Appliances	New
Kitchen Countertop	Upgrade
Cabinet	Upgrade
Exterior	Poor

Classify property condition based on image.

The Models that Power ACE

HVE: Home Value Explorer

- An Automated Valuation Model (AVM) is any computerized model used to determine an estimate of value for real property.

HVE is Freddie Mac's automated valuation model (AVM)

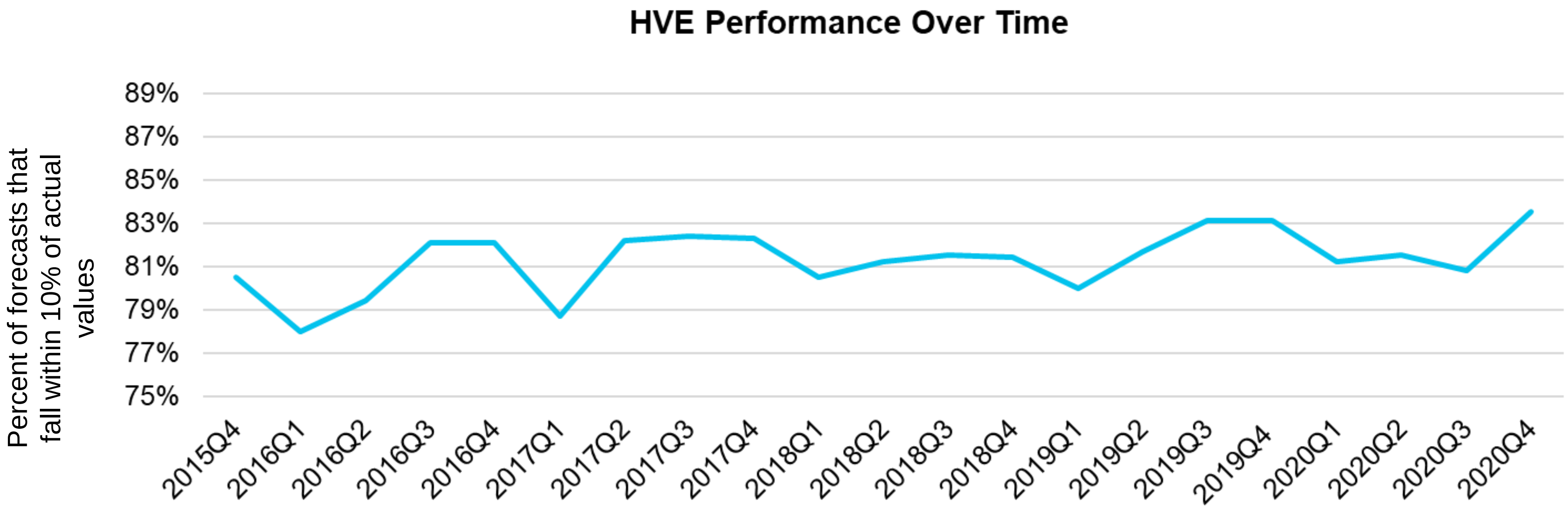
- Outputs include point estimates of property value and the FSD measuring the precision of the estimated property values.
- Estimates the fair market value for single-family, condo, coops, and 2-unit properties in the United States (~ 100 million properties).
- HVE follows Freddie Mac model governance which covers data quality controls, model updates, and performance monitoring.
- **Ensemble model that applies machine-learning techniques to huge swaths of Freddie Mac and vendor-acquired data.**

Freddie Mac’s Home Value Explorer (HVE)

HVE was designed and is continually enhanced for the purposes of managing risk at Freddie Mac.

- The FSD output by HVE is property specific.
- HVE is used throughout the organization to support important functions such as pricing, costing, and QC.
- Significant Freddie Mac resources are focused on HVE’s accuracy, precision, and coverage.

HVE: Performance Is Fit for Use



Notes: PC10 is a common metric used for measuring AVM performance. It measures the percentage of the forecasts that are within +/- 10 percent of the actual sales price.

Freddie Mac completed a study that evaluated refinance loans funded prior to, during, and after the crisis. ("Evaluating the Accuracy of Home Appraisals Using Refinance Transactions", Liyi Liu et al. addresses 2000-2009 findings.) to assess the predictive power of appraisals and HVE.

CCE: Collateral Condition Evaluator

Developed model to better detect properties in poor condition and replace or complement ACE condition rules.

- Waive appraisals on fewer properties in poor condition.
- Waive appraisals on more properties in good condition.
- **Applies Data Robot and machine learning in the cloud to research, develop, test, and deploy the model.**

Comparing Default and Loss for Appraisal and HVE Valuations at Different LTVs

- Examine the default and loss performance of LTV categories based on two LTV measures:
  - Appraised-based LTV and HVE point estimated LTV (Appraisals are risk-weighted to match HVE sample).
  - Compute D90+ default rates and pre-MI loss amount per origination UPB, by origination year.
  - Calculate pre- and post-HVCC average defaults as the simple average of the 2000 to 2008 and 2010 to 2017 years.
- Data—Freddie Mac rate-term refinances from 2000 to 2017:
  - Calculate ever D90+ from funding date to February 2020, and loss amounts through September 2020.
  - Restrict to Single-Family one-unit properties with a 30-year FRM.
  - Exclude HVEs with FSD above 40%; Use HVE values as of LPA scoring date.
- Findings:
  - In the post-HVCC period, appraisal-based LTVs have similar default and loss rates relative to HVE-based LTVs.
  - In the pre-HVCC period, appraisal-based LTVs have substantially higher default and loss rates relative to HVE-based LTVs.
  - The appraisal minus HVE default and loss rate differentials are greatest for higher LTVs loans.

As we evaluate new valuation capabilities our vision is to ensure we purchase loans supported by the most effective valuation methods available to mitigate risk associated with default.

Automated Collateral Evaluation (ACE) Update

- ACE is designed to leverage HVE’s Forecast Standard Deviation so that loans funded with ACE are expected to perform at least as well as loans supported by appraisals (on a risk adjusted basis).
- ACE eligibility was expanded in March 2020 to include cash-out refinance transactions (up to 70 TLTV for primary and 60 TLTV for second homes) as well as no-cash out refinance transactions up to 90 TLTV.
- We see larger ACE offer rate on refinance as compared to purchase transactions, driven by lower LTVs and availability of more data.
- The Collateral Condition Evaluator model deployed in 2019 further improved our ability to identify poor condition properties and reduced the false positive rate.
- We continue to see favorable results when comparing Default Rates (E60 and E90) for ACE loans vs. risk adjusted loans supported by appraisals, even as default rates increased due to COVID-19.

Loan Performance - Ever 90 Day Delinquency Rate
LPA Flow loans by Funding Period
Status as of December 31, 2020

	Funding Period											
	2017		2018		2019		2020Q1		2020Q2		Total	
Total Loans	**Loan Count**		**Loan Count**		**Loan Count**		**Loan Count**		**Loan Count**		**Loan Count**	
ACE funded loans	11,106		39,964		171,404		89,247		268,725		580,446	
ACE Peer Group[2]	106,098		151,734		206,353		55,590		152,175		671,950	
Avg FICO												
ACE funded loans	749		755		759		761		763		761	
ACE Peer Group[2]	753		753		756		757		757		755	
Avg LTV												
ACE funded loans	68		67		67		66		66		67	
ACE Peer Group[2]	69		70		69		68		66		69	
Ever 90 Day Delinquent Rate	**Loan Count**	**bps**	**Loan Count**	**bps**	**Loan Count**	**bps**	**Loan Count**	**bps**	**Loan Count**	**bps**	**Loan Count**	**bps**
ACE Funded Loans	229	256	879	246	3,446	221	1,658	213	1,379	58	7,591	147
ACE Peer Group[2]	2,689	316	3,843	288	4,992	261	1,305	253	1,074	77	13,903	232
		better		*better*		*better*		*better*		*better*		*better*

Notes: 1. Excluded loans in disaster areas that Freddie Mac owned before disaster dates.
2. ACE Peer Group is defined as loans within ACE Credit Box but delivered with an appraisal.

The Road Ahead

Collateral Valuation and Appraisal Resources

Freddie Mac is committed to reinforcing the integral role of appraisers and appraisals in the mortgage process, while developing new and enhancing existing valuation methods. Our goal is to purchase loans supported by the most reliable and appropriate valuation methods available to mitigate the risk associated with default.

sf.freddiemac.com/working-with-us/appraisers/overview

COVID-19 Pandemic Provided Natural Experiment

- Desktop Appraisals permitted on eligible purchase transactions.
  - Rational for allowing the use of desktop:
    - Greater availability of data for appraiser to leverage.
    - Sales price established by willing buyer and seller each acting in their own best interest.
    - Interior/exterior inspection appraised values meet or exceed contract price 91% of time over last 4 years.
  - Freddie Mac analyzed ~230k desktop appraisals completed for Single-Family dwellings using Loan Collateral Advisor.
  - Desktop appraisals showed no elevation of overvaluation risk when compared to traditional (interior and exterior inspection) appraisals. Condo appraisals had similar results.
- Drive-by (exterior inspection appraisals) were permitted on eligible no-cash out refinance transactions where mortgage being refinanced was owned by Freddie Mac, among other requirements.
  - Freddie Mac valuations team analyzed random sample of drive-by appraisals.
  - Most prevalent defect noted was the use of assumption related to property condition. Appraiser must support their condition conclusion with data and cannot assume average condition.
- Overall desktop and drive-by appraisals represented < 2% each of Freddie Mac fundings between March and December 2020.

The Models that Power AIM

AIM Helps Us Manage Risks

- Removes subjectivity and manual errors by applying consistent rules to all loans.
- Receives data directly from the source via trusted third parties, thereby reducing fraud associated with traditional documentation.
- Moves QC review "up front" on all loans and eliminates highest frequency defects.

Continually Managing Risk

AIM Broad Offerings Overview

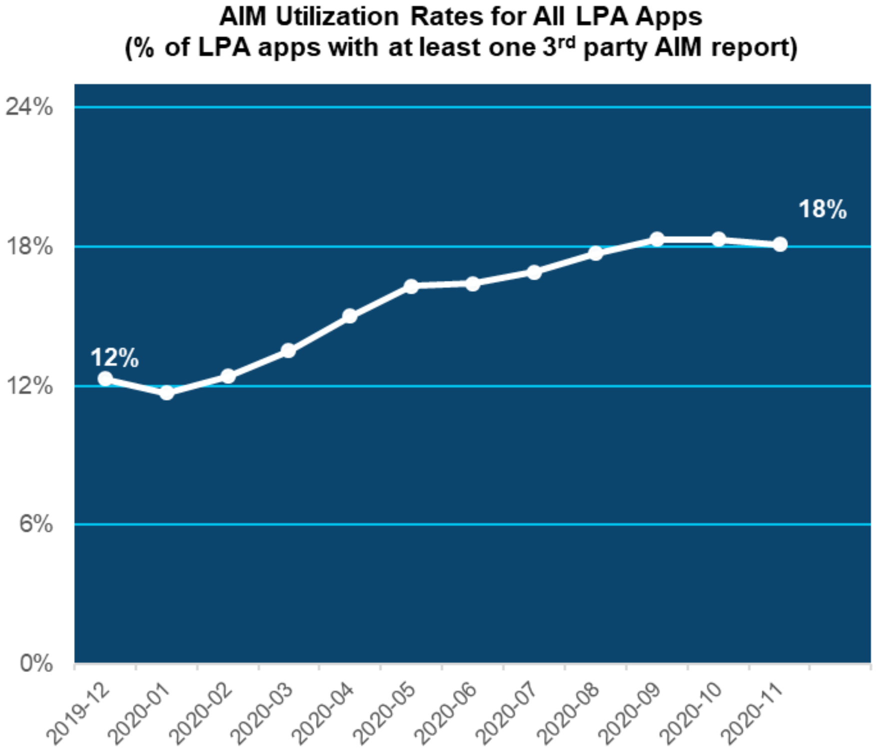
Offering	What is it	Vendors	Adoption (% of LPA Apps)	New and Upcoming Enhancements
AIM for Assets	LPA's automated asset assessment capability that uses Asset data from third-party service providers	▪ FormFree ▪ Finicity ▪ PointServ ▪ Blend	6.7%	• Adding assessment of investment accounts • Identify tax refunds, payroll, and transfers labeled as large deposits
AIM for Income	LPA's automated income assessment capability that uses employer income data from Equifax	▪ Equifax	13.2%	• Evaluate previous and current employment together when current employment is less than 12 months

AIM for Income (Payroll Provider)	LPA's automated income assessment capability that uses payroll provider data from third-party service providers	▪ Finicity
		▪ Coming soon:
		  ▪ PointServ
		  ▪ Blend
		  ▪ FormFree
			TBD	• Broad rollout of payroll provider data into LPA

AIM for Self Employed	LPA's automated income assessment capability that uses tax return data from third-party service providers	▪ LoanBeam ▪ CoreLogic ▪ LoanCraft	0.5% (4% of SE Apps)	• Added 2 new vendors (LoanCraft and CoreLogic) • Added tax transcript to verify tax return data • Adding Rental as an eligible income source • Allow tax extensions

AIM Continues to Gain Momentum

Where are we now?



What do we plan to do?

Strategic Activities:

1. Execute on our adoption outreach strategy
2. Add new offerings and vendors
3. Enhance existing offerings attractiveness
4. Meet industry's desire with Payroll provider offering

Where do we want to be?

25% Utilization By 2021

AIM Continues to Evolve

Bank Data

- Leverage natural language processing and machine learning to categorize bank transaction data.
- Explore evaluating borrowers' capacity using alternative methods on how borrowers manage their money.
- Set the foundation for less reliance on DTI.

Data Expansion

- Leverage income data from major payroll providers.
- Use additional IRS data sources (transcripts, additional schedules).
- Embrace power of OCR to assess paystubs and W-2's for more traditional borrowers.

Panel Discussion: CRT Program Updates

CHRISTIAN VALENCIA

VICE PRESIDENT
SINGLE-FAMILY CRT
CAPITAL MARKETS
FREDDIE MAC

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SINGLE-FAMILY CRT
MORTGAGE INSURANCE
FREDDIE MAC

MEET THE SPEAKERS

Opening Remarks

MIKE REYNOLDS

Vice President, Single-Family Credit Risk Transfer

Mike Reynolds is the vice president of Freddie Mac's Single-Family Credit Risk Transfer (CRT) program. CRT comprises capital markets, reinsurance, and mortgage insurance, including the Structured Agency Credit Risk (STACR®) and Agency Credit Insurance Structure (ACIS®) family of credit securities – multi-billion dollar programs that transfer mortgage credit risk to private investors.

Mr. Reynolds has over 20 years of GSE experience and joined Freddie Mac in 2012 to help launch the Single-Family CRT program. Prior to Freddie Mac, he was vice president of strategic initiatives at Fannie Mae. Earlier in his career, he worked on automated underwriting.

Welcome

MIKE HUTCHINS

President, Freddie Mac

Mike Hutchins is president of Freddie Mac. He is a member of the company's Senior Operating Committee and reports to the chief executive officer. The leaders of the company’s Administration, Enterprise Operations & Technology, Human Resources, Investments & Capital Markets, Multifamily, and Single-Family divisions report to him.

Hutchins has worked in the financial services industry for over 30 years. Most recently, he was co-founder and CEO of PrinceRidge. Prior to founding PrinceRidge, he was with UBS from 1996-2007, holding a variety of positions, including the global head of the Fixed Income, Rates & Currencies Group. Prior to UBS, Hutchins worked at Salomon Brothers from 1986-1996, and held a number of management positions, including co-head of Fixed Income Capital Markets.

Economic and Housing Market Update

SAM KHATER

Vice President and Chief Economist, Economic and Housing Research

Sam Khater is vice president, chief economist and head of Freddie Mac's Economic and Housing Research division. He is responsible for research, analysis and forecasts of the macroeconomy, with a special focus on housing and mortgage markets. As a compelling spokesperson with a unique ability to translate complicated subjects, he is regularly quoted in national, local and real estate trade media outlets.

Mr. Khater came to Freddie Mac from CoreLogic, where he served as vice president of research and deputy chief economist. His responsibilities included producing original research and advising clients, regulators, policymakers and investors on real estate and mortgage market trends. Prior to joining CoreLogic, Mr. Khater was a senior economist at Fannie Mae and an economist at the National Association of Realtors®.

Credit Risk Management Overview

TERRI MERLINO

Senior Vice President and Chief Credit Officer, Single-Family Business

Terri Merlino is senior vice president and chief credit officer for Freddie Mac’s Single-Family business. As chief credit officer, Ms. Merlino leverages her broad-based knowledge of mortgage operations, sales, processing, underwriting, quality control and secondary marketing activities to substantially and positively impact Freddie Mac’s mortgage credit risk management efforts, as well as our client experience.

Prior to Freddie Mac, Ms. Merlino held the roles of chief credit officer and chief risk officer at New Penn Financial. Before New Penn Financial, she spent many years at PHH Mortgage as senior vice president, credit and operational risk, where she was responsible for fostering a risk-aware culture through her leadership of all aspects of credit and operational risk management.

Counterparty Credit Risk Management

KATIE SHILINSKY

Vice President, Single-Family Counterparty Credit Risk Management

Katie Shilinsky is the vice president of counterparty credit within the Single-Family division. She leads teams responsible for managing the counterparty risk profile of Seller/Servicers, mortgage insurers and reinsurers. She also manages the Single-Family teams responsible for manging fraud, third-party risk, executing operational risk exams and ensuing counterparty compliance and eligibility.

Prior to joining Freddie Mac, Ms. Shilinsky worked at GE Capital, where she was the credit governance leader for the lending and leasing portfolios. Her responsibilities included establishing and implementing risk management policies and practices as well as ongoing management of credit limits, thresholds and tolerances. Prior to GE Capital, she worked for the Federal Reserve Bank of Richmond as a quality assurance team leader and senior bank examiner.

COVID-19 and Our Major Models

MICHAEL BRADLEY

Senior Vice President, Single-Family Modeling and Analytics

Michael Bradley is senior vice president of modeling, econometrics, data science and analytics in Freddie Mac's Single-Family division. He is responsible for setting the modeling and analytics strategy and positioning Freddie Mac to become the best credit guarantor. This is a critical role, since Freddie Mac relies on data-driven modeling and analytics to guide functions such as buying loans, valuation and hedging, predicting defaults/severity, and conducting risk management, to name a few.

Mr. Bradley was with Freddie Mac from 1991 to 2003. Among his roles during that time, he served as vice president and general manager of Strategic Information Services, where he helped innovate and bring Home Value Explorer® to market. He returns to Freddie Mac after serving as senior vice president of the consumer analytics and modeling unit at Citigroup and, most recently, as senior vice president of the decision analytics and research team at CoreLogic.

CRT Program Updates

CHRISTIAN VALENCIA

Vice President, Single-Family Credit Risk Transfer Capital Markets

Christian Valencia is the vice president of credit risk transfer (CRT) capital markets in Freddie Mac's Single-Family business. He manages the core transaction team that issues STACR® (Structured Agency Credit Risk) notes, Freddie Mac's flagship CRT program. Some of the STACR program enhancements he has led include moving the program to actual losses from fixed-severity, issuing STACR under a Trust Structure, taking the STACR program to REMIC, and issuing the first Government Sponsored Enterprise (GSE) CRT transaction indexed to the Secured Overnight Financing Rate (SOFR).

An industry veteran with over 20 years of experience in capital markets, Mr. Valencia has worked in structured finance in both the U.S. and abroad, most recently as CFO leading the treasury and structuring departments of a securitization company in Ecuador.

CRT Program Updates

JEFFREY SHUE

Director, Single-Family Credit Risk Transfer Reinsurance

Jeff Shue is the director of Credit Risk Transfer (re)insurance within the Single-Family business. His work includes leading the product development and management efforts for Agency Credit Insurance Structure® (ACIS®), Freddie Mac's reinsurance credit risk transfer vehicle. The program has transferred risk on $2.1 trillion of Single-Family loans across 72 transactions since inception in 2013.

Mr. Shue has 20 years of experience in mortgage finance and credit risk management. Since 2002, he has held several positions at Freddie Mac in the pricing, costing, capital and credit modeling groups, and led the development of the ACIS program from 2012 to 2016. Between 2016 and prior to returning to Freddie Mac in 2019, Mr. Shue worked as a managing director in Aon Plc's Credit Guaranty and Government group, focused on building new reinsurance-based CRT solutions for commercial and public entity clients.

CRT Program Updates

MIKE TIMMICK

Director, Single-Family Credit Risk Transfer Mortgage Insurance

Mike Timmick is the director of Credit Risk Transfer mortgage insurance in the Single-Family business. He and his team are responsible for overseeing and directing Freddie Mac's business relationships with our approved mortgage insurers. This includes strategic coordination on credit, affordable and servicing initiatives; and monitoring MI operational performance on Freddie Mac claims. Mr. Timmick's other responsibilities include establishing Freddie Mac's requirements for the mortgage insurance master policies and collaborating with the mortgage insurers on the review and approval of all master policy documents and related issues such as policy endorsements.

Mr. Timmick has over 30 years of experience in the mortgage industry. Prior to joining Freddie Mac in 2013, he held a variety of risk management positions with Lehman Brothers, JPMorgan Chase, General Electric and Fannie Mae.